

SAJOUS'S
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OF
PRACTICAL MEDICINE

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SAJOUS'S

ANALYTIC CYCLOPEDIA

of PRACTICAL MEDICINE

I

IODINE AND IODIDES.—

Iodine (*iodum*) is a solid, non-metallic element obtained from the ashes of seaweeds as well as from crude Chilean saltpeter. It was discovered by Courtois, a Parisian soda manufacturer, in 1812, and was first used in medicine by Coindet, of Geneva, in 1819. Though occurring most abundantly in deep-water seaweeds, iodine may also be detected in certain fresh-water plants, such as the water hemlock and water cress, as well as in the oyster, codliver oil, eggs and certain mineral springs. A common mode of preparation of iodine is to place the ashes of burned seaweed (kelp) in water, thus dissolving out the soluble salts, to remove chlorides and carbonates by evaporation and crystallization, to treat the residual mother-liquor with manganese dioxide and a mineral acid, and heating the mixture, when iodine can be distilled off.

Iodine occurs in friable, scaly crystals, bluish-black in color, having a metallic luster, and of a hot, acrid taste. It is soluble only in about 5000 parts of pure water, but dissolves readily in water containing salts, potassium iodide in particular. It dissolves in 10 parts of alcohol at ordinary temperatures, in

50 parts of glycerin, and is freely soluble in chloroform, ether, carbon disulphide, and glacial acetic acid. It volatilizes slowly upon continued exposure to the air, but, when heated, fuses at 114° C. and is dissipated in beautiful violet vapors at 180° C.

Iodine imparts a dark-yellow or brown color to all organic substances over which it is applied, except starch and all tissues containing it, which it colors blue owing to the formation of starch iodide. The blue coloration of this compound is so pronounced that it is made to serve as the basis of various tests for iodine. It is thus possible to detect this element in 450,000 times its weight of water. To ascertain the presence of iodine (in the form of iodides) in urine, fuming nitric acid is added to the latter. Iodine, if present, is thereby set free, and is usually recognized by shaking the mixture with chloroform, into which the iodine dissolves readily, imparting a characteristic purplish color. Previous partial evaporation of the urine facilitates the detection of iodine in it. Where an ammoniacal urine is being tested, Gillet advises that potassium hydroxide be added to it, in order that the color of the iodine may not be

missed through decomposition of the ammonia and formation of colorless iodine compounds with its components.

PREPARATIONS AND DOSES.

—The official preparations of iodine, including the salts containing it, are as follows:—

Iodum (iodine), containing not less than 99 per cent. of pure iodine. Dose, $\frac{1}{10}$ grain (0.005 Gm.).

Tinctura iodi (tincture of iodine), containing in each 100 c.c. 7 Gm. of iodine and 5 Gm. of potassium iodide. Dose, $1\frac{1}{2}$ minims (0.1 c.c.). [The iodine tincture of the B. P. contains but 2.5 per cent. of iodine, but the liniment of iodine (*liquor iodi fortis*, B. P.) contains 12 per cent. The French tincture contains about 11 per cent., and the German and Italian tinctures, 10 per cent.]

Tincture of iodine, up to 30 drops thrice daily, is often well borne where KI is not. Richter (*Deut. Aerzte-Zeit.*, 4, 1902).

Extensive application of the tincture to the skin showed that iodine is not, as believed, readily absorbed. Wetzel and Sollmann (*Jour. Pharm. and Exper. Therap.*, Apr., 1920).

Liquor iodi compositus (compound solution of iodine, Lugol's solution), an aqueous solution containing not less than 5 per cent. of iodine and 10 per cent. of potassium iodide. Dose, as alterative, 3 minims (0.2 c.c.); as antidote, up to 1 dram (4 c.c.).

Unguentum iodi (iodine ointment), made by triturating 4 parts each of iodine and potassium iodide with 12 parts of glycerin, then gradually incorporating 80 parts of benzoinated lard and mixing thoroughly, avoiding the employment of a metallic spatula. The ointment should be freshly made before use.

Acidum hydiiodicum dilutum (diluted hydriodic acid), a solution of hydriodic acid [III] containing 10 per cent. by weight of the absolute acid. It is made by dissolving 135 parts of potassium iodide and 10 parts of potassium hypophosphite in distilled water, and 136.5 parts of tartaric acid in diluted alcohol, mixing the resulting fluids together, cooling the product in ice-water for several hours, passing it through cotton, washing the bottle and crystalline precipitate with diluted alcohol until 1000 parts of clear solution have been obtained, evaporating off all the alcohol on a water bath, and adding enough distilled water to make 1000 parts. The product is a colorless liquid, having an acid taste, and miscible in all proportions with water or alcohol. Dose, 8 minims (0.5 c.c.).

Potassii iodidum (potassium iodide) [KI], occurring as colorless, cubical crystals or a white, granular powder, with a faint iodine-like odor, a sharp, saline taste and a bitter after-taste. It deliquesces slightly in moist air. It is soluble in 0.7 part of water, 12 parts of alcohol, and 2.5 parts of glycerin. Dose, $7\frac{1}{2}$ grains (0.5 Gm.) and upward.

Unguentum potassii iodidi, N. F. (ointment of potassium iodide), made by dissolving 10 parts of potassium iodide and 0.6 parts of potassium carbonate in 10 parts of water by trituration, then gradually adding 80 parts of benzoinated lard and incorporating thoroughly.

Sodii iodidum (sodium iodide) [NaI], occurring as colorless, cubical crystals or a white, crystalline powder, odorless, and with a saline and slightly bitter taste. It deliquesces in moist air and may undergo decomposition, assuming a brown tint. It is soluble in 0.5 part of

water and 3 parts of alcohol. Dose, $7\frac{1}{2}$ grains (0.5 Gm.) and upward.

Ammonii iodidum (ammonium iodide) [NH_4I], occurring as small, colorless, cubical crystals or a white, granular powder, odorless when undeteriorated, and with a sharp saline taste. It is very hygroscopic and, through loss of ammonia upon exposure to air and light, liberates iodine, becoming yellowish and giving off a slight iodine odor. It is soluble in 0.6 part of water and 9 parts of alcohol. Dose, 4 grains (0.25 Gm.) and upward.

Strontii iodidum (strontium iodide) [SrI_2], occurring as colorless, hexagonal plates, odorless, and with a bitter, saline taste. It deliquesces, and is colored yellow by exposure to air and light. It is soluble in about 0.5 part of water, also dissolves readily in alcohol, and is slightly soluble in ether. Dose, $7\frac{1}{2}$ grains (0.5 Gm.) and upward.

Zinci iodidum, U. S. P. VIII (zinc iodide) occurring as a deliquescent, white, crystalline powder, having a sharp saline taste. It is soluble in water, alcohol, and ether. Dose, 1 to 2 grains (0.06 to 0.13 Gm.).

Sulphuris iodidum, N. F. (sulphur iodide; sulphur subiodide), obtained by triturating 1 part of sulphur with 4 parts of iodine, heating gradually to the boiling point of water, and pouring the resulting liquid on a cold surface. It occurs in grayish-black masses having a metallic luster, an odor of iodine, and a somewhat acrid taste. It is almost insoluble in water, but dissolves in 60 parts of glycerin, and is very soluble in carbon disulphide. Alcohol, ether, or solutions of potassium iodide dissolve the iodine, leaving the sulphur. It gradually loses iodine upon exposure

to the air. Dose, 1 grain (0.06 Gm.). Used chiefly externally as local alterative and antiparasitic in 10 per cent. ointment.

Syrupus ferri iodidi (syrup of ferrous iodide). See IRON.

The following preparations containing iodine are semiofficial, being recognized in the National Formulary:—

Tinctura iodi fortior, N. F. (Churchill's tincture of iodine), containing in each 100 c.c. 16.5 Gm. of iodine, 3.3 Gm. of potassium iodide, and 2.5 Gm. of water. Dose, 1 minim (0.06 c.c.).

Tinctura iodi decolorata, N. F. (decolorized tincture of iodine), containing, not free iodine, but ammonium iodide. For external use.

Liquor iodi phenolatus, N. F. (phenolated solution of iodine; Boulton's solution; French mixture), containing in every 3 fluidounces (100 c.c.) 24 minims (1.5 c.c.) of compound iodine solution, 10 minims (0.6 c.c.) of liquid phenol, and $\frac{1}{2}$ ounce (16.5 c.c.) of glycerin. For external use.

Liquor iodi causticus, N. F. III (Churchill's iodine caustic), made up as follows: Iodine, 6 drams (25 Gm.; potassium iodide, $1\frac{1}{2}$ ounces (50 Gm.); water, 3 ounces (100 c.c.). For external use.

Linimentum iodi, N. F. III (iodine liniment), an alcoholic liniment containing in every 3 fluidounces (100 c.c.) 4 drams (12.5 Gm.) of iodine, 75 grains (5 Gm.) of potassium iodide, 55 minims (3.5 c.c.) of glycerin, and 100 minims (6.5 c.c.) of water. For external use as discutient.

Phenol iodatum N. F. (iodized phenol), consisting of a mixture of 1 part of iodine and 1 part of glycerin with 3 parts of phenol. A preparation for external use.

Collodium iodi, N. F. (iodine collodion), consisting of flexible collodion to which has been added 5 per cent. of iodine. Employed locally to produce the action of iodine.

Liquor hydrargyri et potassii iodidi, N. F. (solution of potassiomeric iodide; Channing's solution), made up as follows: Mercury biniodide, 15 grains (1 Gm.); potassium iodide, 12 grains (0.8 Gm.); distilled water, 3 ounces (100 c.c.). Dose, 3 minims (0.2 c.c.).

Among the more important unofficial preparations of iodine are:—

Iodipin (iodized sesame oil), a yellow, oily fluid, tasting only of oil, and being essentially an addition product of iodine with the oil. It is prepared by the action of iodine chloride on sesame oil, and is supplied in two forms containing, respectively, 10 and 25 per cent. of iodine. Its action is that of the iodides, but is less sudden in advent and more prolonged. Dose, hypodermically, $\frac{1}{2}$ to $1\frac{1}{2}$ fluidrams (2 to 6 c.c.) of the 25 per cent. preparation; internally, 1 to 2 fluidrams (4 to 8 c.c.) of the 10 per cent. preparation.

Iodipin should be heated to body temperature before being injected and a serum syringe should always be employed having a capacity of from 10 to 20 c.c. ($2\frac{1}{2}$ to 5 drams). The injections are best given under the skin of the abdomen, which is first, of course, thoroughly sterilized, and after the injection the puncture should be closed by means of surgical plaster. One should avoid using massage, which only tends to produce irritation and is, moreover, unnecessary. James Burnet (Lancet, Sept. 8, 1906).

Iodalbin, a reddish powder, with but little taste, and possessing a peculiar, sweetish odor. It is a compound of iodine and blood-albumin, and contains

about 21.5 per cent. of iodine. It is practically insoluble in the ordinary solvents, but dissolves slowly in alkaline solutions. Iodine fumes are evolved when it is heated. When ingested it passes practically unchanged through the stomach, but dissolves in the alkaline intestinal juices and acts in a manner similar to the soluble iodides. Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Iothion, a heavy, yellowish, oily fluid, chemically di-iodohydroxypropane [$\text{CH}_2\text{I}.\text{CHOH}.\text{CH}_2\text{I}$], and containing 77 per cent. of iodine. Its odor is peculiar but not unpleasant, and though insoluble in water, it dissolves in oils, glycerin, alcohol, etc. It volatilizes at the temperature of the body and is decomposed even by weak alkalies. Acting like iodine and iodides, iothion is used externally, being applied in the form of a 25 to 50 per cent. ointment, made up with equal parts of petrolatum and lanolin. It is said to undergo prompt absorption through the skin.

Sajodin, a colorless, odorless, tasteless and insoluble powder, chemically calcium moniodobenenate [$(\text{C}_{21}\text{H}_{42}\text{ICOO})_2\text{Ca}$], and which should contain 26 per cent. of iodine and 4.1 per cent. of calcium. The compound becomes yellow superficially upon exposure to light, but this change is not accompanied by any important degree of decomposition. When heated, sajodin gives off vapors of iodine. It is used internally as a substitute for potassium iodide, over which it is said to have the advantage of relative freedom from untoward by-effects. Dose, 15 to 45 grains (1 to 3 Gm.) *per diem*; single dose, 8 grains (0.5 Gm.).

Airol, aristol, and europen have already been discussed under separate headings, while iodoform and iodol will follow.

MODES OF ADMINISTRATION.—Potassium iodide is best prescribed in a grain-to-the-minim solution in water, of which the patient is required to take the required number of drops in a halfglassful of milk as a vehicle. Sodium iodide is stated by Dock to have no decided advantage over the potassium salt in so far as taste and effect on the stomach are concerned, although certain observers have affirmed the contrary. It is certainly the case that the administration of large amounts of fluid with the iodides is one of the best means of avoiding iodism. Essence of pepsin (1 to 2 drams with each dose) is another vehicle that has been recommended for these salts, while Pfaff has advised the addition of 5 to 15 grains (0.3 to 1 Gm.) of sodium bicarbonate to each dose, in order to prevent free hydrochloric acid in the stomach from breaking the salt down to hydriodic acid. Huchard recommended combining with the iodide Fowler's solution, one drop of which is to be given to every 15 grains (1 Gm.) of iodide, up to 10 or 12 drops a day.

The compound syrup of sarsaparilla has been a favorite with many as a vehicle for iodides. Huhner, when it is desirable to continue the same dose of iodide for a long time, prescribes as follows:—

R Potassii iodidi, ʒj to ʒx (30 to 40 Gm.).

Syrupi sarsaparillæ compositi fʒj (30 c.c.).

Aqua, q. s. ad fʒviij (240 c.c.).

M. Sig.: One teaspoonful in a half-glassful of milk or water three times daily after meals.

The same author warns that a pure preparation of the salt must be obtained, many bad effects being due to impurities.

It is best not to prescribe a 100 per cent. solution of potassium iodide. It is possible to make up such a solution, but only with some difficulty. Most druggists would not take the necessary time and trouble, but probably dispense a weaker solution. Where, therefore, accurate dosage is of importance, it is safer to prescribe a 50 per cent. solution, 2 drops to equal 1 grain (0.065 Gm.) of the drug. Huhner (N. Y. Med. Jour., April 1, 1905).

The dosage of potassium iodide is often to be made an ascending one. For this purpose, beginning, for example, at 10 drops of the grain-to-the-drop solution three times daily just after or a half or full hour after meals, the dose can be increased by 1 drop a day, or 1 drop every dose, etc. Often it is wise to discontinue the drug every three or four weeks for a few days, after which it is resumed at about half the amount at which it had been stopped, and then augmented as before.

Sodium iodide is preferable to the potassium salt. The usual minimum dose is 1.25 c.c. (20 minims) of a saturated solution in a glassful of water three times daily, one-half hour after meals. This dose can be increased by 0.3 c.c. (5 minims) daily up to 24 c.c. (400 minims) three times daily if desired, or to the point of iodism. During the administration of the heroic doses the patient should be instructed to drink copiously of water. Brunson (Amer. Med., May 14, 1904).

In children it is best to give the iodides very frequently in small doses— $\frac{1}{4}$ grain (0.015 Gm.) every hour. A convenient plan is to dissolve the daily dose in 24 teaspoonfuls of water and have the child take 1 spoonful every hour while awake and 2 or 3 spoonfuls on awakening after a two or three hours' sleep. In this way a six-month child may take as much as 15 or 30 grains (1 or 2 Gm.) in twenty-four

hours for a long time without inconvenience (Huhner).

Iodine in organic combination (sajodin, etc.) remains a longer time in the system than potassium iodide, though less promptly absorbed. For mild forms of disease the organic preparations are suitable, but where a rapid action is desired, the inorganic are, in general, to be preferred.

The iodized proteins seem to be of advantage for therapeutic use only in so far as they avoid gastric irritation. The iodized fats and fatty acids seem to have some advantages when the continuous action of small amounts of iodine is desired. They are more slowly and evenly split. Their use in **arteriosclerosis**, **bronchial asthma**, **lead-poisoning**, etc., probably has some rational basis, therefore, on physiological grounds. The difference in frequency of iodism is probably due to the difference in the amount of available iodine present in the body at any one time. When large amounts of iodine are desired, as in **cerebrospinal syphilis**, avoiding the danger of iodism would be at the sacrifice of therapeutic efficiency. F. C. McLean (Archives of Intern. Med., Nov., 1912).

Where potassium iodide is not tolerated by stomach it may be administered by rectum, given in water, or, better, in milk, in doses of 15 to 30 grains (1 to 2 Gm.) three times a day. Its absorption is as rapid by this route as when it is given by the stomach, and may be even further accelerated by heating the solution to body temperature before its introduction. Potassium iodide can also be used hypodermically, pain being minimized if lukewarm water is employed. The subcutaneous use of iodipin is a valuable adjunct to treatment, notably in syphilitic disease of the nervous system and in chronic inflammatory conditions in general (Burnet).

To avoid gastric disturbance from iodine the writer sought an easily made compound in which it would be loosely combined with an organic substance. The formula for his preparation is:—

R Iodine 2.5 Gm. (38 gr.).
 Tannic acid ... 4 Gm. (1 dr.).
 Alcohol (90 per cent.) 38 c.c. (1¼ oz.).
 Syrup, q. s. to make 75 c.c. (2½ oz.).

The iodine is dissolved in the alcohol. The tannic acid and 30 c.c. (1 ounce) of the syrup are then added. The solution is heated to just below the boiling point until it gives no evidence of iodine with the starch reaction. This requires about twenty minutes. It is then cooled, and the remainder of the syrup is added with flavoring. Each dram (4 c.c.) contains 2 grains (0.12 Gm.) of iodine. It may be given in doses of from ½ dram (2 c.c.) to 2 drams (8 c.c.) in water or wine before meals, according to age. The combination is especially well tolerated by children, and proved useful in cases of **chronic lymphadenitis**. It is indicated in children with **large faucial** and **pharyngeal tonsils**, in whom operation is contraindicated or objected to. V. H. W. Windgrave (Lancet, April 6, 1904).

To avoid irritating the gastric mucosa and to reduce to a minimum the phenomena of iodism, the author administers potassium iodide as follows:—

R Potassium iodide
 (chemically pure) gr. cl (10 Gm.).
 Sodium bicarbonate (chemically pure) gr. cxx (8 Gm.).
 Dry sodium phosphate 3j (4 Gm.).
 Dry sodium sulphate 3ss (2 Gm.).
 Boiled water Oij (1000 c.c.).

M. Sig.: Dessertspoonful in water three times daily.

Bourget (Théráp. des mal. respiratoires, 1911).

Pure iodine is used chiefly externally. In addition to the official tincture, compound solution and liniment, various solutions or ointments have been formulated for special purposes. Thus, Talbot, for purposes of oral disinfection, recommends the following combination, which he terms iodoglycerole:—

℞ Zinc iodide 3 parts.
 Water 2 parts.
 Iodine 5 parts.
 Glycerin 10 parts. —M.

As compared with the ordinary tincture this preparation shows much greater astringency, while the glycerin causes rapid penetration, and irritation is minimized. The glycerin also prevents the preparation from mixing with the saliva and running over the mouth. By frequent applications to the gum margins and teeth, the lips and cheeks being held away from the jaws until the iodine has dried, tooth decay can be arrested and oral disease greatly reduced. Before operative work in the mouth this solution can be used to disinfect the mucous membrane.

The solution of iodine which the author applies to mucous membranes is as follows: To equal parts of glycerin and water is added tincture of iodine, 1 dram (4 c.c.) to the ounce (30 c.c.), with a little belladonna and phenol as local sedatives. This solution is applied through a simple hand atomizer to the throat and nose, uterus, vagina, urethra, or skin. In using the atomizer, the patient holds the tube between the teeth with lips closed, in the same position as in smoking a pipe, and breathes through the nose. The bulb is worked vigorously, and the fine spray will be seen issuing from the nostrils, showing plainly that the whole interior of throat and nose is covered with the spray. Even small children readily learn to "smoke a pipe" in this way, and may have their

throats pleasantly and painlessly disinfected many times a day. Stabler (Med. News, June 25, 1904).

Following method of preparing "glycerole iodine" recommended: Add 1 ounce (30 Gm.) of resublimed iodine to 12 ounces (360 c.c.) of alcohol, and sufficient potassium iodide to effect solution. Distill this over in a glass retort. To the product thus obtained, add sufficient commercially pure glycerin to make 1 pint (500 c.c.). One now has iodine in a form readily absorbed into the circulation through the skin or mucous membranes. The glycerin holds it in solution on the skin until it is all absorbed, leaving no stain—unlike the tincture. For constitutional effects it is best to apply it over the inguinal and other glands, or over the side, ribs, or breast. The author uses it in chronic catarrh, applied on the inside of the nose with a cotton swab, and also on the outside of the nose. In painful **rheumatic** or **gouty joints** the relief it affords is almost instantaneous. He also uses it in **goiter**, **adenitis**, **croup**, **bronchitis**, **coryza**, **la grippe**, **colds**, **hoarseness**, **scrofula**, **syphilis**, **glandular enlargements**, **splenic** and **hepatic enlargements of chronic type**, **caries**, **chorea**, **cachexias** in general, etc. T. W. Williams (Med. Summary, Feb., 1905).

For external application with the intention of securing systemic absorption of iodine the following combination has been advised:—

℞ Iodine 3j (4 Gm.).
 Spirit of ammonia ... 3j (30 c.c.).
 Oleic acid 3ij (60 c.c.).
 Liquid petrolatum ... 3iv (120 c.c.).
 M.

If potassium iodide is incorporated with lanolin or resorbin and rubbed on the skin, no absorption occurs, but if 10 per cent. olive oil or petrolatum is added to the lanolin, iodine can be detected in the urine. Two or 3 Gm. ($\frac{1}{2}$ or $\frac{3}{4}$ dram) of the ointment applied to the inner surface of a limb is all that is required. Hirschfeld

and Pollio (*Archiv f. Derm. u. Syph.*, Nov., 1904).

If iodine be painted on the human skin in the dark, only a red light, such as that of an ordinary photographic lantern, being used, and the part immediately covered without exposure to white light, absorption will be rapid and there will be neither discoloration nor blistering, even after prolonged use. J. Dunbar-Brunton (*Brit. Med. Jour.*, Nov. 16, 1907).

Petrolatum and vasogen are good vehicles for potassium iodide to be absorbed through the skin, while wool-fat and lard give poor results. For iodoform petrolatum is also the best vehicle. Herzfeld and Elin (*Med. Klinik*, March 3, 1912).

Rapid absorption of iodine into the system can be secured by vaporization and inhalation. Thus Alter saturates a small amount of wool or absorbent cotton with tincture of iodine, ignites it and allows the patient to inhale the fumes as it burns. If this be done in a closed room, the air becomes charged with the vapors of iodine, and the latter will act more markedly than by ordinary methods of administration. The author has employed this method in catarrhal respiratory affections, tuberculosis, syphilis, etc. For the relief of dyspnea a little potassium chlorate may be added with advantage.

Minshall has had favorable results in affections of the nasal mucous membrane with a spray of iodine in purified liquid petrolatum.

For a description of the technique of "iodine fumigation" the reader is referred to the section on Therapeutics.

INCOMPATIBILITIES. — Iodine is incompatible with alkalis, alkaline earths, alkaloids, ferric salts, salts of mercury, tannic acid, oils and starch. With ammonia and oil of turpentine explosive compounds may be formed.

Tincture of iodine is incompatible with water.

The chief incompatibilities of potassium iodide are with the ordinary soluble metallic salts, with strychnine, hydrated chloral, tartaric acid, calomel, silver nitrate, potassium chlorate, alkaloidal salts, and with strong mineral acids.

CONTRAINDICATIONS.—In individuals known to have a marked idiosyncrasy to iodine, or in cases with organic disease of the kidneys or heart, the administration of preparations containing it, especially in large doses, is attended with some danger.

In pulmonary tuberculosis, or where there is merely a tendency to it, the administration of iodine or iodides is by many held to be unwise. Wells and Vetlesen observed the potassium salt to induce, or aggravate when already present, cough, expectoration, hyperemia, and râles in the affected or suspicious area in a large proportion of early cases of phthisis.

Yvert warns against placing yellow mercuric oxide ointment or calomel into the eye or mercury oxycyanide in the bladder of a patient who is taking iodine in any form. The iodine would act upon the mercury compound to produce mercurous iodide which, in the presence of an excess of iodine, would decompose into metallic mercury and the markedly caustic mercuric iodide, the latter causing aggravation of the local trouble. This mistake is most likely to occur in "strumous" children being given syrup of iron iodide internally and presenting also phlyctenulæ.

Acne rosacea and dermatitis herpetiformis are stated by Crocker to be aggravated by the use of iodides. In bullous eruptions he considers their use dangerous.

There is necessity for great caution with iodine in cases of arteriosclerosis with enlargement of the thyroid. Hyperthyroidism brought on by iodine does not cease when the iodine is suspended and it may progress to a serious form, as in several of the author's patients, who had taken but 1 Gm. (15 grains) of potassium iodide daily for two weeks. L. Krehl (Munch. med. Woch., Nov. 22, 1910).

To test for iodine in urine or saliva the writer stirs with the end of a match a little calomel into a few drops of the urine on a slide. If it contains iodine, the calomel turns bright yellow. Iodine in the saliva is shown up in the same way if the patient spits on a little calomel. This calomel test is extremely delicate and reliable. Another way to reveal the presence of iodine is by touching the tongue with a silver nitrate stick. The mark resulting is not white but yellow in case the individual has been taking iodine. Lesser (Berl. klin. Woch., Nov. 4, 1913).

In normal subjects potassium iodide, injected *intravenously*, is eliminated in a parallel manner in the urine and saliva. In cases of renal insufficiency it might *a priori* be supposed that an increase of elimination with the saliva would occur. As a matter of fact, the saliva eliminated no more iodide than the urine in these cases. The iodide seems to be fixed and retained by the tissues under these conditions. Ameuille and Sourdel (Presse méd., Apr. 24, 1919).

PHYSIOLOGICAL ACTION.

Externally.—When applied to the skin, iodine stains it a yellowish brown, owing to its actual penetration into the cells and combination with their protein constituents. Acting at first as a slight irritant, iodine causes, when repeatedly applied at short intervals, or when the preparation used is too concentrated, destructive changes which result in the shedding of the superficial cells and a

slowly developing reactive inflammation in the less seriously affected deeper structures. Its application induces a sensation of heat, together with burning or itching; there occurs dilatation of the superficial vessels, some edema and exudation of leucocytes, and in many instances vesicle formation. The more deeply lying vessels are believed to be, on the contrary, reflexly contracted, this probably accounting for the value of iodine as a counter-irritant.

Excessive irritation by iodine may cause pustules to form and deep inflammation to occur, with subsequent scarring. Iodine can be absorbed through the skin.

To remove iodine alcohol is the most effective agent, for it has itself a distinct bactericidal power. Hypo-sulphite of soda forms with iodine the soluble sodium iodide, which may be washed off with sterile water. This works best when the solution is quite warm, but it is not as effective as a solution of potassium iodide. This substance in a 10 per cent. solution can be thoroughly sterilized by boiling, and acts as a good solvent for the dried iodine. Later the surface is flushed off with sterile water. Hunter Robb (Surg., Gynec., and Obstet., Sept., 1913).

Upon mucous membranes iodine acts strongly but only superficially. Its tendency is to destroy tissues of low vitality and simultaneously excite healthy tissues to greater activity.

According to Lillie, potassium and sodium iodide are, next to the cyanides, the most active substances in increasing the permeability of cell walls, thus causing loss of the cell constituents, with ultimate cellular death. Zallard has shown that sodium iodide, applied over a large area of the skin in a 5 per cent solution, may be absorbed through

it, probably in sufficient amount to produce distinct therapeutic effects.

The destructive action of iodine on cell life is particularly pronounced in respect of micro-organisms. Kinnaman in 1905 showed iodine to be far superior to bichloride of mercury as a germicide. While the *Streptococcus pyogenes* was not destroyed by exposure for fifteen minutes to a 1:1000 solution of the mercury salt, a 1:500 solution of iodine killed the organism in two minutes. The *Staphylococcus pyogenes aureus* was killed by a 1:200 solution of iodine in five minutes, the *Bacillus tuberculosis* by a 1:100 solution in seven minutes, and the *B. anthracis* and *B. prodigiosus* by the last-mentioned solution in ten minutes. It is also superior to mercury bichloride in being stable when an iodide is included in its solution, in being non-toxic in effectual strength, in not coagulating albumin or forming inert compounds with tissues, and in possessing far greater penetrating power. The solution employed by Kinnaman in his tests was made up as follows:—

R Iodine 2.5 Gm. (38 gr.).
 Sodium iodide 5.5 Gm. (80 gr.).
 Sterilized water 250 c.c. (8 oz.).
 M.

General Effects.—*Nervous System.*—We have no definite knowledge of the direct effects of iodine on nervous structures, though the tremor, tonic or clonic convulsions, and altered reflex irritability noted after large doses would seem to indicate some excitant influence on nervous tissue on the part of such doses, and, as a matter of fact, accumulation of iodine in nerve-structures has been observed in cases of experimental intoxication in animals. Other phenomena, however, such as headache, prostration, vertigo, insomnia,

and mental confusion, are attributed by some to modifications in the blood-supply to the cerebral and medullary centers.

Circulation.—Reports upon the circulatory effects of iodine and iodides have been contradictory. Some authors have assumed a vasodilator action. According to Pouchet, moderate doses cause at first a fall in the blood-pressure, the power of the heart beats remaining, however, as before, and the rate being, if anything, slightly increased. (Hunt observed that the accelerator mechanism of the heart was less subject to fatigue after the administration of an iodide than before.) The reduction in pressure would suggest the existence of vascular dilatation, but Pouchet asserts that there occurs actually a vasoconstriction instead, and that the lowering of pressure is due in reality to a diminution in the total amount of fluid circulating in the vessels, the researches of Henrijean and Corin having shown the red-cell count to be enormously increased three hours after an iodide injection. The excess of fluid is asserted to pass out of the vessels not only through the kidneys, but by transudation into the serous cavities, into the lungs (pulmonary edema), and even, in certain cases, into the subcutaneous tissues. In a second phase of the circulatory effects of iodine, the blood-pressure rises again to above normal, and the heart rate, if previously accelerated, sinks to about the usual figure. This condition is due both to persisting vasoconstriction and to a return of fluid into the blood-vessels through the lymphatics, as is shown by a secondary fall in the number of red corpuscles per cubic millimeter, which at times betokens even a certain degree of hydremia.

These phenomena occur as well, if not quite as markedly, where sodium iodide is used as with the potassium salt, and hence are to be attributed directly to the iodine ion.

Toxic doses of iodine give rise, according to Pouchet, to the following series of circulatory changes: (1) Immediate slight increase of heart rate; (2) slowing, with increased amplitude of heart beat, and constant blood-pressure; (3) diminished cardiac strength, with blood-pressure remaining, nonetheless, practically the same; (4) further cardiac weakening, with accelerated rate and a marked fall in blood-pressure. In general iodine diminishes the irritability of depressor and inhibitory nerve-structures, and, on the contrary, excites the sympathetic. It is especially or exclusively free iodine which acts directly on the circulation; minute amounts of the element added to fluid that is being perfused through a turtle's heart are sufficient to arrest its action, while much more concentrated solutions of sodium iodide are required to produce the same effect.

On the whole, valid experimental evidence that the iodine in iodides acts as a vasodilator is conspicuously lacking. Stockman and Charteris concluded from their clinical and experimental observations, moreover, that neither potassium nor sodium iodide when given to man by the stomach in ordinary doses, depresses the heart or lowers the arterial blood-pressure.

Lymphatic System.—Iodine is credited by Martinet and others with being a lymphagogue, this in turn being related to the transudation of fluid from the blood-vessels into the tissues which was referred to in the preceding section. The lymph, becoming more rich in salts than normally, owing to the addition

of those from the blood, extracts water from the surrounding tissues or pathological exudates. This extra fluid then re-enters the blood-stream, carrying with it waste material washed from the tissues, which material is soon eliminated through the emunctories. Where this process remains within certain limits, therapeutic effects are alone produced; where it proceeds too far, however, edema—even pulmonary edema—is the result.

Another effect of iodine having to do with the lymphatic system is that of markedly stimulating lymphoid tissue in general, as well as serous membranes, the result being a pronounced increase in the production of lymphocytes, especially where small doses are used and only for a short time (Lortat-Jacob). If excessive doses be given, or smaller ones for too long a time, sclerosis of the spleen and lymph-nodes may instead be induced (Pouchet).

Secretions.—Iodine and iodides tend to increase the flow of secretions from most glands, especially the salivary, buccal, nasal and lachrymal glands. Its elimination takes place in part through these channels. The sweat secretion is, however, not much affected by it, while the mammary secretion is diminished or even checked. The output of urine may be temporarily augmented.

Metabolism.—Iodine markedly enhances tissue change, as is shown by the increase in total urinary nitrogen which constantly follows its administration. The phosphates in the urine are likewise increased only temporarily, by alkaline iodides or organic compounds of iodine. The elimination of chlorides is greatly augmented, sometimes threefold,—an eloquent exemplification of the lymphagogue action of iodine. Proteins and fats with which iodine combines in the

system are thereby rendered more susceptible to decomposition. Hence the loss of body weight which the administration of iodine or iodides in sufficient dosage may produce, and the observation of Winternitz that animals could be fattened on iodized fats only if the proportion of iodine contained in the latter was kept below a certain small percentage (Pouchet). The respiratory quotient, *i.e.*, the ratio of oxygen taken in to carbon dioxide eliminated, is increased by iodine, this showing that compounds rich in oxygen are reduced to form compounds poor in oxygen and extra carbon dioxide. The resulting compounds can only be fats, and this harmonizes with the fact that in animals subjected for prolonged periods to large daily doses of iodides, fatty degeneration, especially of the liver and kidneys, may be observed.

Apparently the influence of iodine in causing tissue destruction is exerted particularly on the more simple or recently acquired forms of cells. Fibrous tissue is thus particularly susceptible to its destructive or softening effect, as exemplified in the use of potassium iodide in various sclerotic conditions.

Absorption and Elimination.—

Iodine may be absorbed in small amount when applied to the skin. Taken internally, it is freely absorbed, but enters the blood as an iodide or in combination with proteins, as it readily enters into chemical unions of various sorts and cannot long exist free in contact with the tissues. The resulting iodine compounds are however, themselves readily decomposed by various agencies, and it is considered likely that, at least for a time, the action of free iodine in small amount is exerted upon the economy. In view of the foregoing, it will readily be seen that the effects of

iodine and iodides must be to a great extent the same.

The average absorption of sodium iodide, quantitatively, is about the same for all divisions of the small intestine; from the stomach and colon it is about a third less. The absorption from the intestine was at first very rapid, from 50 to 75 per cent. being absorbed within ten minutes; then the absorption was greatly checked or completely arrested, so that from 25 to 50 per cent. might remain unabsorbed at the end of two hours. Visible hyperemia induced locally by various drugs increased, while visible anemia diminished the absorption of iodide. Injury of the intestinal epithelium, however produced, hindered the absorption. Feeding dogs on a chloride-poor diet, thus rendering the tissues in general poor in chlorides, did not appear materially to increase the absorption of sodium iodide. Hanzlik (*Jour. of Pharm. and Exper. Therap.*, March, 1912).

In a pharmacological study of the distribution of iodide compounds in normal animals, rabbits, guinea-pigs, and a few dogs and cats the iodide compounds, potassium iodide chiefly, iodopin, sajodin and iodine-albumin, were given subcutaneously and per os. The quantity of iodine in various organs and tissues was quantitatively determined.

1. When an iodine compound is absorbed, the iodine is usually found in largest quantities in the blood and wherever blood is present. Used therapeutically as potassium iodide, the iodine is found in fatty tissues, the brain and spinal cord, besides the blood. This controverts the assertion of Loeb and Von den Velden that iodine is not lipo- or neuro-trope. 2. The amount of iodine contained in 1 Gm. (15 grains) of any organ; the iodine content of each quantitatively is in the following order: blood, kidney, lung, liver, muscle and brain. Other organs show various amounts under different con-

ditions. The kind, mode of use or quantity of the iodine compound have no marked influence on the distribution of the iodine. 3. Although a part of the iodine is fixed in the organs, one cannot tell whether it is secreted specially by any organ.

4. *a.* Iodine in blood serum and plasma occurs only as potassium iodide when this salt is used and cannot be found as organic compound. In coagula and the blood corpuscles, iodine occurs in organic compound with fat and lipid, but not with proteid. *b.* When iodine-proteid is used, the iodine is found in the blood both in fat and lipid, but also with proteid. *c.* When the iodine-fat is used, the iodine is found in the blood combined with fats and lipoids but not with proteids. *d.* The quantity of iodine combined with fat and lipid is least when potassium iodide is given, greater when iodine proteid and greatest when iodine-fat is administered. *e.* The iodine combined with fat and lipid diminishes gradually and disappears after a time from the blood, even when iodine is still present as potassium iodide. It disappears soon when potassium iodide is used, but long after when fat is given.

5. Iodine is always combined with fat and lipid in the organs, but not with proteid. The amount of the iodine combined with fat and lipid is larger and remains much longer in the organ than in the blood. 6. The hair contains a large quantity of potassium iodide, but iodine combined with fat is recognized at times and not at others. However, the horny substance usually takes up iodine although perhaps in very small proportions. 7. Potassium iodide is absorbed, though very slowly, from the mucous membrane of the rabbit stomach and absorbed more rapidly when it has passed to the intestine. It is fairly easily, though slowly, absorbed from the rectum. Iodipin is not absorbed within 6 hours from the gastric mucous membrane of rabbits and is absorbed very slowly from the

rectum. A part of the iodipin is split in the intestine and forms potassium iodide before its absorption. 8. Iodine is quickly and abundantly excreted from the stomach and intestines and is found there as potassium iodide. A part of it soon combines with proteid or fat or lipid. 9. Iodine passes easily into the sweat and is excreted there in the form of potassium iodide. 10. Iodine also passes into the milk, mostly as potassium iodide. Kamji Fujisawa (*Sei-I-Kwai Med. Jour.*, Jan. 10, 1918).

Once absorbed, iodine or its compounds is taken up by the body cells, the amount present in various tissues depending upon the relative affinities of the latter for it. According to Labbé and others, iodine is taken up abundantly in the spleen and lymph-glands and next in the liver. Iodine is also stored, in still larger amount, in the thyroid gland, becoming a constituent of the colloid material present in the intercellular spaces. The amount of thyroglobulin in the thyroid gland is increased by the administration of iodine. From the thyroid and other organs iodine is later gradually released, whether as such or in combination has not yet been determined.

When potassium iodide is absorbed in health it does not remain in any demonstrable quantity in the brain, the fat, or the bone-marrow. It can be found in the liver, kidneys, lungs, the blood, and the thyroid gland. Disease in these and other tissues alters their adaptability to retain iodine, so that tuberculous or carcinomatous tissue contains more iodine than the same tissue in health. Secreting glands which are diseased by syphilis contain from three to six times as much as normal blood, and the less severe the syphilis, the greater the readiness of the tissue to hold iodine. In such tissues the iodine is in an organic combination, presumably an iodine and albumin

compound being formed. O. Loeb (Arch. f. exp. Pathol., Bd. lxi, S. 108, 1912).

The writer found that Bier's method of stasis hyperemia was enhanced in value in **surgical tuberculosis** by giving at the same time potassium iodide internally. In 12 persons and in rabbits there was a remarkable retention of the iodide in the edema fluid and tissues in the segregated limb. The retained iodine is not eliminated when the constricting band is removed, but remains stored up in the tissues for a time. Salomon (Mitteil. a. d. Grenz. d. Med. u. Chir., Bd. xxvii, Nu. 1, 1913).

According to Pouchet, the leucocytes are especially charged with the task of distributing iodine in the system. Under the microscope, these cells can be observed to absorb iodine, showing for a time a reddish-yellow crescent at their periphery, after which the element is quickly changed to "masked" iodine, *i.e.*, iodine so combined that its ordinary chemical reactions can no longer be elicited. Contact of an iodine solution with a serous surface causes a prompt afflux of leucocytes, which become agglutinated, and endothelial desquamation. The appearance of numerous large mononuclear leucocytes, as well as some macrophages or phagocytic cells, is a marked feature of the resulting situation, and suggests that iodine is a specific excitant of defensive lymphocytic activity.

Potassium iodide circulates not only in the plasma, but also in the corpuscles. The greatest quantity is found in the lungs. The author thinks that the iodide acts as itself, and not in virtue of its iodine. In the case of iodipin, when injected, iodine is found in the urine for a long time afterward; but when it is taken by the mouth it forms a fatty substance which is not excreted by the kidney.

Lesser (Archiv f. Derm. u. Syph., t. lxiv, 1903).

The elimination of both iodine and iodides occurs in the form of the latter, chiefly through the kidneys, and in less proportion with the saliva, respiratory passages, sweat and mammary secretion. Large doses of iodine tend to irritate the kidneys, as shown by the appearance of albuminuria and possibly, in rare instances, nephritis. Broeking has shown that the excretion of potassium iodide in the urine amounts to nearly 80 per cent. of the quantity ingested. The principal excretion takes place during the first few hours, and within the first twelve hours about 75 per cent. of the total excreted iodine is demonstrable in the urine; the remainder is eliminated, at least in the case of a single small dose, within sixty hours. Only traces appear in the feces. Rogovin found that iodine can be detected in the urine usually after 0.005 Gm. ($\frac{1}{12}$ grain) and sometimes even after only 0.002 to 0.003 Gm. ($\frac{1}{30}$ to $\frac{1}{20}$ grain) of potassium iodide has been given by mouth. According to Mérière, absorption of iodides takes place and elimination with the saliva begins on an average in from eight to ten minutes, though if the stomach is quite empty and the iodide is given in warm tea, this period may be shortened to two or three minutes; where the stomach is full, there is, on the other hand, a delay of thirty or forty minutes.

Fischel found iodine in the urine only in the second hour after administration of sajodin by mouth, showing that this organic combination of iodine is more slowly absorbed than the inorganic iodides.

After one dose of $\frac{1}{2}$ Gm. ($7\frac{1}{2}$ grains) of potassium iodide the freest excretion usually occurs within two hours. After such a dose, on

an average, 75 per cent. is excreted in the urine, sometimes more. The duration of the excretion after such a dose is about forty hours. If two doses are given within five hours, the excretion persists for fifty-six hours. Three doses within ten hours cause the excretion to persist for seventy-seven hours. When the drug is given in a mucilaginous mixture, the excretion is delayed, apparently as the result of imperfect absorption. Potassium nitrate and sodium chloride cause an increase in the excretion. Sodium bicarbonate has no influence upon the excretion or upon the production of an iodide rhinitis. The secretion of the nasal mucous membrane in iodide rhinitis contains iodine in from 0.9 to 1.5 per cent. of the amount administered. *Anten* (*Arch. f. exper. Path. u. Pharm.*, Bd. xlviii, H. 5 u. 6, 1903).

The use of strontium salts in therapeutics has been to some extent discouraged, it being thought that such salts are more slowly absorbed than the corresponding salts of sodium and potassium. Testing the excretion of strontium iodide in the human subject in comparison with that of sodium and potassium iodides, the writers found practically no difference in the rate of excretion of the 3 compounds. If anything, both the rate of excretion and the total excretion seemed to be slightly greater with the strontium salt than with the other 2, though the difference is held to be immaterial. The excretion of strontium iodide not being slower, neither is its absorption to be considered slower, since all iodides are believed to exist in the blood and tissues essentially as sodium iodide. *Krahulik and Pilcher* (*Arch. of Internal Med.*, Jan., 1918).

UNTOWARD EFFECTS AND POISONING. IODISM.—The untoward effects most frequently met with from iodine or iodides are the earlier manifestations of chronic iodine poisoning or "iodism." Coryza and profuse discharge from the mucous mem-

brane of the upper respiratory tract, ptyalism, and an acneiform eruption generally starting over the shoulder-blades constitute, in the majority of cases, the initial symptoms of this condition. There may also be noticed puffiness of the face, a peculiar metallic taste, particularly early in the morning, slight tenderness of the teeth and gums, lack of appetite for breakfast, frontal headache, lachrymation, and sore throat. These phenomena may appear after only a few doses have been taken in persons with a distinct unusual susceptibility to the drug, but in the majority of instances they do not occur until the dose administered has become quite large.

Case in which potassium iodide caused deafness and tinnitus. Recovery was imperfect. A warning is sounded against the reckless use of potassium iodide in aural disease. *G. B. McAuliffe* (*Jour. Amer. Med. Assoc.*, May 2, 1908).

Because of a slight ailment indicating potassium iodide, the author took three doses of about 2 grains (0.13 Gm.) each in solution, at intervals of three or four hours. Before the second dose, the conjunctiva of his right eye began to inflame; after the second dose it became rapidly worse, and after the third dose it became so bad that he suspected the iodide as the cause, and so took no more. The inflammation persisted, in spite of treatment, for a week. Two weeks after the first attack he took two doses of 2 grains (0.13 Gm.) each, in solution, and became quite convinced that the iodide had caused the first inflammation, as well as the second.

Some time after he took a dose of iodide in solution, unintentionally, not exceeding 4 grains (0.26 Gm.); five or six hours afterward the conjunctiva of the right eye became highly inflamed, exuding sticky mucus, and the upper and lower eye-

lids very edematous; this was accompanied by severe pain and heat in the eyeball. Vision was unaffected. He also became slightly hoarse, and had a slight aching in the larynx. Upon application of cold-water packs the trouble subsided in thirty-six hours. T. Julian (*Chicago Med. Times*, Oct., 1908).

A man aged 67 applied tincture of iodine on three successive days to painful areas following intercostal neuralgia, and covered it with oil-cloth. Some days later an eruption suddenly appeared, consisting of acne-like papules with small pustules upon the tops, surrounded by a red halo. This eruption spread over the whole body. Upon the limbs and the trunk there was also a macular eruption. There was no fever or other constitutional disturbance. There was some inclination to regard the eruption as either varioloid or varicella. Hodara (*Dermat. Woch.*, Nu. 10, 1912).

Sudden total blindness following the application of a 10 per cent. iodine solution over a severe tenosynovitis and a Colles fracture. In four days the patient developed a general edema of the arm and herpes of the arm and left side of the face, which also became edematous; after about four days this subsided. In four days after the subsidence of these symptoms she awoke in the night to attend to something for her children and found she could not see at all: she could not tell where the light was. Besides the blindness she had a complete paralysis of both upper lids.

While paralysis of the various oculomotor branches and of the levator palpebrae has been reported, no case of blindness is mentioned, though under the caption "Bromide Poisoning" there are such mentioned. The not infrequent occurrence of sudden death after fractures resulting from thrombosis suggest this as a possible cause for the blindness. E. J. Bernstein (*Ophthalmology*, Oct., 1913).

In severe cases there may be distinct nausea, diarrhea, marked headache, malaise and progressive emaciation and anemia. The skin eruption may assume various appearances, advancing from a simple acne or dermatitis to an exanthem simulating that of small-pox, varioloid, pemphigus, purpura, eczema, etc. Sometimes large boils appear. There may also develop parotitis, cardiac palpitation, sweating and fever.

A patient had been ordered a saturated solution of potassium iodide. On the fourth day he was taking three doses of 13 drops each. On this day his finger-tips showed slight cyanosis. The drug was discontinued for the entire fifth day and the local cyanosis disappeared within twenty-four hours.

On the sixth day, one single dose of 14 drops was given. During the night there appeared a diffuse ecchymosis under the entire skin of all the fingers and thumbs, stopping very abruptly at the metacarpophalangeal joints. The fingers, in addition, were numb, cold, stiff, slightly swollen, and very painful. The little finger of each hand was almost absolutely black. The extreme tip of the nose was similarly affected, though less severely. The toes remained entirely normal, but there were a few isolated, mild purpuric spots on the thighs and on one arm.

Under the assiduous application of warmth and friction, the condition very gradually subsided. It was nearly three days before the patient felt quite reassured that the fingers and nose were safe from gangrene. There had been no gastric irritation, coryza, acne, or any other symptom of iodism. Gathmann (*Med. Record*, Jan. 30, 1904).

A man, aged 52 years, presented an eruption of tumor-like and papillary elevations scattered over the scalp, face, trunk, and extremities after taking considerable doses of iodide of potassium. The eruption was accompanied by some elevation of

temperature and evidences of renal insufficiency. One of the most characteristic lesions, situated on the forehead over the left eye, was a quarter-dollar-sized, soft, rounded tumor with a broad, constricted base and ulcerating summit. A portion of this tumor examined microscopically showed a structure closely resembling epithelioma, there being the same connective-tissue *loculi* filled with atypical epithelial cells. D. W. Montgomery (Jour. of Cutan. Dis., Feb., 1904).

Case of tertiary syphilis in which the administration of three 10-grain (0.65 Gm.) doses of potassium iodide caused a variolous rash. Small-pox was present in the town, but it was excluded in this case for the following reasons: (1) absence of its prodromal symptoms; (2) mature, reticular nature of the eruption; and (3) hemorrhagic nature of the eruption, unaccompanied, at first, by grave illness of the patient. The diagnosis was confirmed by the appearance of bullæ and by the reappearance of the rash when iodide was readministered. Hynes (Lancet, Feb. 13, 1904.).

Purpuric eruptions caused by the ingestion of the iodides may be divided into two provisional groups. The first group includes the extensive petechial and hemorrhagic bullous cases, which occur in those individuals with organic disease, particularly of the kidneys or the heart, or with a lowered condition of the general economy, making them more susceptible to the effect of the drug, or with a strong idiosyncrasy to the same. The second group includes all cases with a localized distribution, particularly those in which the eruption is limited to the lower extremities or the lower legs, which occur in individuals in perfect health, and are explainable only in that a mild idiosyncrasy to the iodide is present.

Mild symptoms of iodism were present in a few of the 61 cases collected by the author, and severe reaction to the drug was noted in 2 cases. Edema of the glottis was

found in 2 instances. Lesions were found on the mucous membranes in a few cases. Organic disease of the kidneys and heart were found in but 10 cases. The various salts of iodine are capable of causing a purpuric eruption.

Hemorrhagic bullous cases of extensive distribution are frequently fatal, 7 out of 11 quoted ending fatally. Petechial, non-bullous cases rarely terminate in death, unless there is marked disease of the heart or kidneys or a very extreme intolerance to the drug; 2 out of the 50 cases of this type ended fatally. F. C. Knowles (Jour. Amer. Med. Assoc., July 9, 1910).

A man of 65 with signs of amyotrophic lateral sclerosis was given potassium iodide and his temperature soon rose to fever heat. The iodide was discontinued, after which the temperature subsided to normal; but it rose again each time iodine in any form was given except by percutaneous cataphoresis of iodine salts. The thyroid was persistently normal. In a second case a woman of 33 presented the clinical picture of acute circumscribed thyroiditis on two occasions. It was learned that each had followed the local application of an iodine salve without medical advice; the thyroid was slightly enlarged. Konried (Med. Klinik, June 25, 1911).

In a friendly scuffle a young man was scratched by a finger-nail on the left side of the neck. The area was painted with tincture of iodine, no further dressing being employed. Next day the area over which the iodine had been applied was raised, reddened, and indurated, its general appearance being suggestive of ringworm. This was excluded, however, by the absence of itching and its development overnight. Erysipelas was thought of, but there were no constitutional symptoms, local warmth, or lymphadenitis. Tincture of iodine, 1:10, was then applied and the area left uncovered. Next day, the area was sloughing superficially, with a

copious serous discharge. The patient stated a blister had formed and broken during the night. A smear showed very few organisms, namely: staphylococci and bacilli, but no streptococci. The area was lightly curetted while being irrigated with an aqueous solution of iodine, 1:1000. Sterile gauze was then applied, which the following day was soaked with serous discharge. The erythematous area was greatly extended, involving the adjacent portions of the scalp over which the iodine solution had trickled. Exfoliation and isolated pustules followed. Smears from the pustules showed immense numbers of polymorphonuclear leucocytes, but no organisms. An area of the right forearm was painted for experimental purposes. The iodine was mostly washed off during the day; but in spite of its relatively transient action, the arm became swollen, passing through the same stages of erythema, vesiculation, with copious serous discharge, exfoliation, and pustulation. Healing was sluggish, a profuse serous discharge continuing the while. A. G. Wilde (Military Surgeon, Sept., 1913).

Iodism is essentially an iodine intoxication which, according to Djelologow, is due to liberation of the nascent element through the effect of some oxidizing agent on the iodides. Thus oxidation of the latter may take place in the blood, in the stomach, or when the iodide is excreted in a locality with which air is constantly in contact, as in the respiratory tract. In persons with high gastric acidity and having in the stomach nitrous acid derived from nitrites present in the saliva or in food, conditions are especially favorable for the liberation of free iodine and production of iodism. Thin ascribes purpuric iodide eruptions to complete destruction of small areas of the vessels, and has demonstrated histologically a limited lesion of this kind.

In occasional cases, especially of syphilis, potassium iodide may suddenly produce intense edema of the glottis, so severe as to necessitate immediate tracheotomy. In a series of 9 such cases collected from the literature by Groenouw, 4 patients had presented the edema on the first day, 1 under a dose of 15 grains, 2 under $7\frac{1}{2}$ grains, and the fourth under as little as 3 grains. All other symptoms of iodine were absent from these cases, and after the disappearance of the edema persistence in the use of the drug produced no unfavorable effects. The likelihood of the occurrence of this edema is diminished by copious ingestion of water when the iodides are taken.

Salivation by mercurials may be either lessened, initiated, or increased by potassium iodide (E. B. Allan).

Atrophy of the mammary glands or testicles has been observed after prolonged administration of iodine or its salts.

In some cases the nervous system exhibits the chief untoward action of iodine. Twitching of the muscles, neuralgic pains in the trunk and limbs, mental disorders, insomnia, hypochondriasis and hysteria have also been noted. At times the neuralgia is sufficiently severe to necessitate discontinuance of the remedy. In rare instances, paralysis of the sphincter muscle of the iris and of the ciliary muscle may be observed.

Another group of cases of intoxication resulting from the administration of iodine comprises those in which there has already been present a latent or manifest tendency to thyroid overactivity. Pre-existing symptoms of exophthalmic goiter are likely to be aggravated by iodine preparations, and many authors have shown that pro-

longed use of iodides may in itself provoke exophthalmos. Römheld has reported a number of cases in which, because of incipient or feared arteriosclerosis, iodine had been administered and the development of serious symptoms suggesting exophthalmic goiter had followed. The severity of the manifestations did not appear to bear any relation to the amount of iodine ingested.

Case of secondary syphilis in which even small amounts of potassium iodide caused a considerable swelling of the thyroid gland with each successive dose. Remarkable about the case was the abeyance of all other symptoms of iodism. Csillage (Wiener med. Woch., Nu. 33, 1905).

A woman of 52 years, four days after taking 20 c.c. ($\frac{2}{3}$ ounce) three times daily of a 5 per cent. potassium iodide solution, developed a well marked uniform swelling of the thyroid gland. On stopping the medication the swelling subsided and on resuming it the enlargement promptly reappeared. The observation is interesting because of the fact that the thyroid gland is the only organ which contains iodine *per se* and experiments on dogs have shown that the thyroid gland is a site of predilection for the deposition of iodine. Lublinski (Deut. med. Woch., Feb. 22, 1906).

Attention has been directed by Comby to the fact that iodism develops only exceptionally in children; the younger the patient, the less the likelihood of its occurring. The reason for this is the rapid elimination of iodine in childhood.

PROPHYLAXIS.—Administration of iodides in ample dilution and in small initial dosage is one of the chief safeguards against iodism. The use of milk as a vehicle is also a rational preventive measure, the protein in it tending to offset any excess of acid in

the stomach and prevent the effect of nitrites on the iodide. Rohmann and Malachowski found that simultaneous administration of potassium iodide and sodium bicarbonate failed to provoke iodism in cases where the ingestion of the former alone promptly induced it.

According to some the best agent for preventing iodism is arsenic in the form of Fowler's solution. This seems in no way to interfere with the action of the iodine preparations. From 2 to 4 drops given during meals in water, the iodides being administered after meals in considerable water, most satisfactorily serve the purpose. Ammonium carbonate, bromides and belladonna have been extolled by other writers, but these agents are likely to provoke unpleasant symptoms when administered for a prolonged period. The bromides are especially objectionable.

The writer found that calcium given with iodides and bromides prevents iodism. This is due to the antagonistic action between calcium and the iodides and bromides. It can be studied on muscle fibers, the latter drugs causing contractions in muscle fiber immersed in them, while the contractions cease when calcium is added to the fluid. E. Frey (Med. Klinik, March 1, 1914).

Bretonneau advises the employment of alkaline benzoates, preferably benzoate of ammonium, for the prevention of iodism. It is best given in cachets each containing 0.25 Gm. (4 grains), of which 4 to 8 may be ordered per diem.

Scrupulous cleanliness of the skin is said to be helpful in avoiding the iodic skin rash.

Exposure of the skin to direct sunlight may contribute to perpetuating an iodide or bromide eruption after the administration of the drug has been stopped. In one of the author's

cases parts protected by the clothing and hat showed no trace of eruption, while the exposed areas were plainly affected. In such cases the patient should remain in a dark room or, if need be, wear a red mask. Where the arms and legs are involved they should be dusted with some simple antiseptic powder or wrapped in a zinc oxide dressing. Arthur Hall (Edinb. Med. Jour., March, 1906).

The author has made it a practice for a long time past to have regular urinalyses made in patients undergoing iodide treatment; in most cases, even in young and otherwise healthy individuals, there were signs of renal irritation at times. Patients previously without a trace of nephritis showed albumin in varying amount and hyaline casts at times. It is desirable to keep track of the urine when administering an intensive iodine course, and to decrease or stop the drug when the excretion shows that the renal functions are being seriously interfered with. He has seen a number of cases of permanent damage to the kidneys due to iodine medication. The great majority of cases of severe iodism, the cases with bullous and hemorrhagic eruptions, have occurred in patients suffering from renal insufficiency. Gottheil (Jour. Amer. Med. Assoc., Oct. 30, 1909).

According to Fournier's observations, if potassium iodide is given in the same moderate dose uninterruptedly, a purpuric eruption produced by it is apt to lessen in severity until there is almost complete disappearance, even while the drug is being given; if, however, the dose is considerably increased, a fresh outbreak will occur, which is usually not so severe as the first attack. If the drug is stopped for a few weeks and the same small dose is given as in the first instance, an eruption will again be produced, but the outbreak will usually not be so severe as the lesions first caused. A certain tolerance, therefore, seems to arise in many individuals who are susceptible

to this drug, but the tolerance is only transitory, as increase of the dose while the drug is being taken in moderate quantities will produce a fresh outbreak, or if the drug is stopped for but a few days the tolerance is lost and the original dose, or even a smaller quantity, will again produce the eruption. Thus a bullous, non-hemorrhagic case was described by Besnier, in which the first outbreak caused by 2 Gm. (30 grains) of potassium iodide, on a second occasion by 1 Gm. (15 grains), and a third time by 0.1 Gm. (1½ grains). F. C. Knowles (Jour. Amer. Med. Assoc., July 9, 1910).

TREATMENT.—In the majority of instances the remedy need not be discontinued when iodism is produced. By reducing the dose the untoward effects may be sufficiently mitigated. It is to be borne in mind, nevertheless, that a number of cases have been reported in which progressively diminishing doses of iodide, administered at intervals, continued to induce iodism in spite of the reduced amount.

To relieve the coryza-like effects of potassium iodide, 5 drops of tincture of **belladonna** given with each dose of the iodide are efficient. **Sodium bicarbonate** in daily doses of from 90 to 180 grains (6 to 12 Gm.) has been asserted to relieve the general manifestations of the poisoning. **Sulphanilic acid** internally in doses of from 40 to 60 grains (2.6 to 4 Gm.) per diem will tend to fix nitrous acid in the stomach.

Lombard prescribes as follows in iodism:—

R. **Sulphanilic acid**,
Sodium bicarbonate ... of each gr. viiss (0.5 Gm.).

M. et ft. in cachet no. j.

Sig.: One cachet four times daily with meals.

In addition, a **diet poor in nitrates**—milk, bread, and meats—should be in-

sisted upon. For the eruptions, anti-sepsis of the skin is important; **baths** and lotions of 1:25,000 **calcium permanganate solution** are useful. Hemorrhage should be treated with **ergotine** and salivation with **potassium chlorate** (Briquet).

ACUTE POISONING.—Ingestion of large doses of iodine is likely to produce at first a marked sensation of burning along the esophagus and in the epigastrium. Great thirst is complained of. A strong, metallic taste, as well as salivation, may also be early symptoms. Soon the irritant effect of iodine on the gastrointestinal mucous membranes asserts itself more strongly and there may follow nausea, vomiting, cramps and purging. There may occur tinnitus, shooting pains, diuresis and sexual excitation. After massive doses, these phenomena may be followed by marked prostration and circulatory depression, the pulse becoming thready and the skin very pale and cold, and later cyanotic. Anuria may exist; if, however, any urine can be obtained, it will be brown in color. The vomitus, containing iodine, is likewise tinged yellow. The later manifestations are increasing nervous excitement, convulsions, and finally a comatose state. Death, if it occurs, is due to respiratory failure; but it is seldom observed, the iodine readily combining with other materials to form non-irritating and easily eliminated compounds.

Bickel showed experimentally that iodine, or an albuminous compound containing it, tends to increase the flow of gastric juice and mucous secretion, *i.e.*, has the power to bring on "acid gastritis."

The quantity of iodine capable of causing toxic symptoms varies considerably in different individuals. While

doses as large as $2\frac{1}{2}$ drams (10 Gm.) have been taken without producing marked effects, 20 grains have been known to induce violent symptoms.

Case of acute and fatal iodine poisoning in a man, aged 70 years, suffering from arteriosclerosis, chronic interstitial nephritis, and hypertrophy of the left ventricle, and who ten years before had contracted severe syphilis. Administration of 15 grains (1 Gm.) of sodium iodide on 2 successive days was followed by iodism and iodine acne. On the same day there appeared subconjunctival petechiae, swelling of the mucous membrane of the nose and throat, dyspnea, and enlargement of both testicles. Later the nares ulcerated. The urine contained albumin and hyaline and granular casts. No iodine was found in the urine. Three days after there occurred inflammatory infiltrations in the skin of the face and trunk, and a phagedenic ulcer formed on the lower lip. The skin of the trunk and extremities was covered with small abscesses and vesicles containing turbid, yellowish-green serum. This condition was followed by double hydrothorax, pulmonary edema, and death. The explanation given of the case was that, owing to the diseased state of the kidneys, the iodine was not eliminated, and the amount retained was sufficient to cause death in such a broken-down subject. Franz (*Brit. Med. Jour.*; *Wiener klin. Woch.*, No. 23, 1899).

Report of the case of a man, aged 59, suffering from a swelling in the sternal region. As this was evidently gummatous, potassium iodide and liq. hydrarg. perchlor. (B. P.) were given; after three doses (amounting to 15 grains—1 Gm.—of the one and 2 drams—8 Gm.—of the other) the medicine had to be discontinued on account of violent vomiting. This having been subdued by lavage, the iodide was recommenced a week later. After taking 20 grains (1.3 Gm.) the patient was suddenly seized

with severe pains in the extremities. An extensive purpuric eruption rapidly developed, he became collapsed, and in thirty hours was dead. There was slight vomiting. *Post mortem*, recent ulcers—becoming gangrenous in places—were found in the stomach and small intestines, particularly the duodenum. The author considers that purpura is due to direct injury to the endothelial cells of the blood-vessels, and that in the case under notice it might have been due to the elaboration of a combined poison by the joint action of potassium iodide and a factor constructed directly or indirectly by tissue metabolism. J. B. Cleland (Brit. Med. Jour., July 11, 1903).

Toxic phenomena have been known to follow the application of iodine over mucous surfaces and its injection into morbid growths. Repin has reported 2 cases in which toxic absorption from tincture of iodine applied in the vagina took place; in 1 of these, symptoms of intoxication appeared in six minutes.

Iodides, apart from iodism, become acutely toxic only when ingested in large quantities. Even then their effect is for the most part limited to salt-action in the gastrointestinal tract, nausea and vomiting, occasionally with diarrhea, being the result.

TREATMENT OF ACUTE IODINE POISONING.—When this is due to free iodine the administration of **white of egg, milk, starch, or starchy foods**, such as **flour or arrow-root**, is indicated in order to fix the iodine and prevent its irritant action on the tissues; the first two antidotes named are to be given preference. Immediately after, the stomach should be evacuated by **lavage** or an **emetic**. **Opium** and **demulcents** may be given to allay pain and protect the mucous membranes. Where a tendency to collapse becomes manifest, stimulants

such as **aromatic spirit of ammonia, caffeine, strychnine, digitalis, and alcohol** should be administered, preferably hypodermically, and **external heat** supplied. To relieve iodine skin lesions **crushed ice** affords relief.

For iodism the writer gives **adrenalin**, at least 0.006 Gm. ($\frac{1}{40}$ grain) a day, in 2 doses, and if this prove insufficient, subcutaneous or intramuscular injections of 0.001 or 0.002 Gm. ($\frac{1}{40}$ or $\frac{1}{2}$ grain). It may be used also for the prevention of iodism. G. Milian (Paris méd., May 5, 1917).

THERAPEUTICS.—In **syphilis** iodine in the form of potassium iodide may be said to be an invaluable remedy in the tertiary stage and for visceral, osseous and nervous manifestations of the disease. An exception to the rule that it is required only for late syphilis is to be made, however, in congenital syphilis in the newborn, in which the exhibition of potassium iodide should be begun early (Comby). Not only should positively syphilitic children receive iodine, but all who present suspicious symptoms, such as coryza, exostoses, etc., or cachexia appearing without apparent cause, are prematurely born, or whose mothers have had frequent miscarriages. It may also be used in the presence of meningeal symptoms, convulsions, pseudoparalysis, **hydrocephalus**, etc. In children with gummatous tumors, bone disease, perforation of the soft palate, etc., its administration is, of course, clearly indicated.

In general the iodides must be exhibited in full doses if satisfactory results are to be obtained. The best plan is to give ascending doses, beginning, in adults, with 10 grains (0.6 Gm.) three times a day, and gradually augmenting the dose by 1

grain (0.06 Gm.) a day until the limit of tolerance is reached. Many patients attain 1 dram (4 Gm.) or more, especially if water is copiously taken at the same time. (For further information, the reader is referred to the section on MODES OF ADMINISTRATION and the article on SYPHILIS.)

Local injections of potassium iodide in cases of **gumma**, especially in dyspeptic subjects, recommended. In a patient in whom 0.5 Gm. (8 grains) of iodide taken internally caused a severe urticaria, the same dose injected in the center of the gummata caused no ill effect. Besnier (*Annales de dermat. et de syph.*, Feb., 1905).

When giving potassium iodide for its specific effect, and not to counteract any particular symptom, the author stops at the first symptom of poisoning, waits a short period, and then changes the dose. In tertiary **syphilis**, especially when some vital organ is threatened, however, he does not stop simply because some pustulation or rhinitis occurs, but continues increasing the dose till more serious symptoms make it impracticable. The method carried out consists in prescribing a 50 per cent. solution (gtt. ij = gr. j), and, starting off with gtt. xx, increase gtt. ij at each dose as follows: First day, 20 drops in the morning, 22 drops at noon, 24 drops at night; second day, 26 drops in the morning, 28 drops at noon, 30 drops at night; third day, 32 drops in the morning, and so on. With this plan ill effects rarely occur, while the increase is rapid enough for ordinary purposes, although under extraordinary circumstances one may augment by 4 drops instead of 2 at each dose. The author has 2 patients taking between 500 and 600 grains (33½ and 40 Gm.) daily, without any annoying symptoms. Huhner (*N. Y. Med. Jour.*, April 1, 1905).

Intravenous injection of potassium iodide advocated in fulminating cases of **syphilis**. Very small doses prove

effectual. The author used 0.1 Gm. (1½ grains) of potassium iodide, giving it in the form of 2 c.c. (30 minims) of a 5 per cent. solution. The injection did not seem to affect the circulation, respiration, or temperature, and caused merely slight pain at the point of injection, generally quite transient. In the severe cases of cerebral syphilis the injection was repeated every day for six days. Doevenspeck (*Therap. der Gegenwart*, Bd. xlv, Nu. 12, 1906).

Report of cases of **cerebral syphilis**, **alcoholic insanity**, **melancholia**, etc., advocating the use of potassium iodide in rebellious or critical cases in very large dosage. Such doses should be taken immediately after meals, and will be borne only when the patient is on a full, heavy diet. In almost every case there was a primary eruption situated principally on the chest and face; in most cases this occurred at from 300 to 500 grains (20 to 32.5 Gm.), with slight nausea. Both disappear on increase of dosage. In many cases of cerebral syphilis, if treatment is begun within three months after mental impairment is first noticed, the patient will regain his normal mental faculties. Walker (*Med. Standard*, March, 1908).

The *modus operandi* of iodine and iodides in resolving gummata and other forms of chronic inflammatory tissue is by no means definitely known. The proteolytic theory of their action is given most credence, and is supported by the febrile manifestations sometimes observed after the giving of iodides. According to this theory, union of potassium iodide with antibodies already present in the infected individual gives rise to a ferment which has the power of digesting certain proteids (granulomatous cells, etc.); in this process toxic substances are formed which create local inflammation in the lesion and at times a general febrile reaction (Capps).

Liénaux and Huynen in 1912 reported having found that iodides bring about marked hyperemia in the vicinity of tuberculous lesions in cows and guinea-pigs (likewise in patches of chronic eczema and scabies in dogs), and likened the action of iodides to that of a Bier hyperemia acting locally in pathological foci, the result being an afflux of blood, increased exudation and diapedesis, and more active phagocytosis. In tuberculous foci the relative paucity of vessels and great resistance of the tubercle bacilli to the action of leucocytes diminishes the probability of a favorable effect of the iodide on the lesions, but in other granulomata these factors are less prominent and the efficiency of the salt correspondingly greater. Potassium has also been credited by some with exerting an antiseptic effect in syphilis and other infections.

In **actinomycosis** the efficiency of iodides in promoting resolution of pathological tissue is practically as great as in tertiary syphilis. Doses of 15 to 30 grains (1 to 2 Gm.) a day are sufficient to produce marked curative effects.

A case of **actinomycosis** of the submaxillary and carotid regions and pharynx was given gradually increasing doses of potassium iodide, up to iodism and copious acne, without effect. A 10 per cent. solution of potassium iodide was then administered by cataphoresis in daily *séances* of from ten to fifteen minutes. Within a few days decided improvement was evident, which continued without interruption.

In another case dermic **blastomycosis** was uninfluenced by the internal use of potassium iodide, vigorous curettage, and cauterization with pure phenol. The ulcerated surfaces were then covered with a compress

saturated with a 1 per cent. solution of iodine and potassium iodide, aided by cataphoresis in daily *séances* of from ten to fifteen minutes. In the course of two months there was complete and permanent healing of the blastomycosis. N. Senn (Amer. Jour. of Dermat., Aug., 1905).

In **arteriosclerosis** potassium iodide is believed, upon prolonged administration, to overcome, in a measure, vascular degeneration, promoting absorption of the cellular infiltration in the vessel walls and thereby enlarging their lumen or improving their elasticity. While this applies especially to cases of **syphilitic endarteritis**, good results are also considered obtainable with the drug in non-specific forms of arteriosclerosis. Vierordt, a champion of the iodides in this condition, begins with doses of only 2 or 3 grains (0.13 to 0.2 Gm.) two or three times a day, and then increases to 15 grains (1 Gm.) thrice daily. This is kept up for eighteen months to three years, with occasional intermissions, and the results thus obtained are claimed to have been very good in all forms of arteriosclerosis. Promotion of the elimination of irritants and waste-products by potassium iodide has also been held responsible for its favorable effects in arteriosclerosis. That any direct effect on the blood-pressure in these cases is exerted is to be doubted. Diminution of the viscosity of the blood may, however, be an operative factor.

A number of rabbits were treated with epinephrin and some others with subcutaneous administration of iodine at the same time. The necrosis of the arteries which inevitably followed the injections of epinephrin could be prevented by simultaneous injection of iodine. A. v. Korányi

(Deut. med. Woch., Bd. xxxii, Nu. 17, 1906).

Case of a man, 65 years of age, complaining of pain over the cardiac region on the slightest exertion, a feeling of giddiness when stooping, weakness of the muscular system, and insomnia. Examination revealed nothing abnormal in heart or lungs; the urine was free from sugar and albumin and of normal specific gravity. But the arteries were very prominent in the temporal regions, and in the arms the radials could be felt halfway up.

The patient took regularly for four months a mixture of iodide and bromide of potassium, of each, 4 grains (0.26 Gm.) three times daily, and was ordered hot foot-baths at night to promote sleeping. Two months after this treatment the caliber of the arteries was so diminished that there was difficulty in tracing the radial any distance from the wrist, and in the temporal regions they were scarcely visible or tangible. J. G. Spitzly (Brit. Med. Jour., Oct. 3, 1908).

Effect of iodine upon viscosity of blood studied in 12 patients with arteriosclerosis and hypertension. A very definite diminution in the viscosity followed in 8 cases. The arterial tension fell during the treatment, as much as 65 mm. of mercury in some instances. The same results were obtained in rabbits by the administration of the iodide of sodium and potassium. The viscosity of the blood was found to be increased or diminished parallel with increase or decrease in the number of red blood-corpuscles. There seems to exist a parallelism between arteriosclerosis, viscosity of the blood, and response to treatment. The greater viscosity is found in the more advanced arteriosclerosis; iodine effects a diminution in viscosity in inverse ratio to the severity of the disease. Boveri (Presse méd., Aug. 15, 1909).

Iodides have a marked hypotensor action in high blood-pressure without arteriosclerosis; in advanced arteriosclerosis with high blood-pres-

sure they have no such action. To produce a beneficial effect in excess of tension, 10 grains (0.65 Gm.) of potassium iodide should be the initial dose. This should be rapidly increased if necessary. Matthew (Edinburgh Med. Jour., March, 1911).

In cases of **aneurism** the favorable influence of potassium iodide is ascribed by Burnet to promotion of clotting in the sac, contraction of the sac then resulting from the formation of a firm clot. The iodides might also do good by eliminating poisons responsible for the arterial degeneration and removing from the vessel coats pathological material, thus restoring elasticity and permitting of contraction of the sac.

Angina pectoris is another of the circulatory conditions in which potassium iodide has proven of value. For it to be of real service, 30 to 60 grains (2 to 4 Gm.) a day should be given, and this should be kept up for months (Burnet). Sclerosis or spasm of the coronary vessels may perhaps be alleviated by the drug, and its beneficial action thus accounted for. Sodium iodide is preferred by Fränkel to the potassium salt.

In various affections of the respiratory tract iodides have proven of considerable service. In **bronchial asthma** they may be relied on to produce good results in most instances. Fairly large doses, for some time, are recommended. An efficacious combination is the following:—

℞ *Potassium iodide* ʒij (8 Gm.).

Water, enough to dissolve the iodide.

Then add

Tincture of belladonna-leaves ʒij (8 c.c.).

Syrup of orange-peel,
enough to make ʒiij (90 c.c.).

M. Sig.: One teaspoonful every three hours.

In **chronic bronchitis**, especially in the elderly, the iodides are not infrequently useful. According to Burnet, if ordered half an hour before meals, they should be taken in a small amount of water, not a glassful. The ingestion of a single large dose of 15 grains (1 Gm.) before bedtime is also recommended. Any gastric disturbance brought on may be relieved by combining ammonium carbonate with the iodide. E. B. Allan points out that even small doses may in some individuals aggravate bronchitis instead of relieve it, causing congestion of the mucous membrane and dyspnea. The drug is thus probably not to be considered applicable to all cases. Externally, iodine liniment may be painted over the chest with advantage in chronic bronchial catarrh.

Iodipin is preferred by Burnet to the inorganic iodides for employment in respiratory diseases, as it produces a more uniform effect. The 10 per cent. strength can be given in 1- or 2-dram (4 or 8 c.c.) doses, mixed with a little warm milk, three times a day; or, tablets of solid iodipin can be prescribed. It should be given on an empty stomach to obtain the most benefit. In cases of **pulmonary fibrosis** with distressing cough and difficult expectoration, most marked early in the morning, good results are obtained by giving a full dose of iodipin at bedtime.

In chronic diseases of the respiratory system only two or three remedies may be absolutely relied on, and one of these is potassium iodide. In **pulmonary fibrosis** as met with in stone-masons, the two drugs which proved of most value were iodide of potassium and ichthyol. With these two remedies alone the author was

often able to alleviate the symptoms very materially. When the dyspnea which in such cases generally results from emphysema becomes marked, iodides given regularly over a somewhat prolonged period almost always afford relief. Burnet (*Lancet*, Sept. 8, 1906).

In **pulmonary tuberculosis** iodine has been recommended, but it is doubtful whether it is productive of much benefit. Inhalations of its vapor, with or without admixture of turpentine, have been extolled as stimulant to the mucous membranes where there is profuse expectoration (likewise in **laryngeal tuberculosis**). The danger of hemoptysis is, however, probably increased by the systemic administration of iodine in any form in lung tuberculosis. In the early stages, local application of iodine over the threatened or diseased area is, on the other hand, of great service. The front and back of the chest may be painted on alternate days. The application of cotton wadding over the painted areas tends to increase the efficacy of the treatment. Intrathoracic injections of iodine have also been used in pulmonary tuberculosis.

[Although the cases were more or less advanced, and other methods had afforded but little encouragement, very distinct amelioration of their condition was obtained. The injections were well borne: no hemorrhage was caused, even where hemoptysis had previously occurred. Two of the patients were children, aged 4 and 10 years, respectively. The solution preferred by d'Amico (*Lancet*, March 29, 1913) consisted of iodoform, 1 Gm. (15 grains); camphor, 2 Gm. (30 grains); guaiacol, 5 Gm. (75 grains); essence of peppermint, 30 drops,—a quantity we deem excessive and needlessly irritating,—and olive oil, 20 Gm. (5 drams). The needle, preferably of platinoiridium, should be of fine caliber and from 3 to 5

cm. long. In adults from 20 to 60 injections were administered, according to the extent of the disease, while in the 2 cases in children 10 sufficed. One c.c. (16 minims) was the amount usually injected, but as much as 4 to 6 c.c. (1 to 1½ drams) were required for cavities. Avoiding the cardiac area and large vessels while introducing the needle into the appropriate intercostal space, the solution is injected directly into the affected pulmonary area. The most favorable region is that comprised between the second and sixth ribs on either side. The apex is best reached through the dorsoscapular intercostal space.

Of the tuberculous nature of the cases treated there could be no doubt. The injections caused disappearance of the tubercle bacilli from the sputum, gradual cessation of the fever and cough, all other physical signs being also gradually eliminated. Open-air exercise and the patient's daily vocations being in no wise interfered with, the cases progressed steadily toward recovery while earning their livelihood—a matter of vast importance when we realize that the majority of cases occur among those most exposed to infection, the working classes of our great cities. S.]

In **pleural effusions**, **pleurodynia**, and circumscribed **pneumonia**, the procedure just described is sometimes remarkably effective, especially if the affected region is kept warm. Internally, Zielinski points out that potassium or sodium iodide can be employed with advantage in persistent forms of croupous pneumonia and the pneumonia following or complicating influenza. Beginning on or about the twelfth day of the disease, doses of 23 to 30 grains (1.5 to 2 Gm.) may be ordered for adults, and proportionately smaller ones for children.

Iodine used by ionization in the treatment of **tuberculosis**. The disappearance of pyrexia, delirium, pleural effusion and improvement in the sputum were remarkable. The author

does not feel inclined in every case of **pleurisy** or **pneumonia** to adopt the treatment unless ordinary treatment fails, as iodism, if it did occur, would add to the distress of the patient. The method is as follows:—

At 9 A.M., the patient is given 25 grains (1.6 Gm.) potassium iodide and 5 grains (0.3 Gm.) potassium bicarbonate in a copious draught of water. At 11 A.M., 1 P.M., and 3 P.M., the dose is repeated. At 4 P.M., with the patient resting in bed, ionization is carried out by means of plates of block tin, thin enough to bend into hollows, each having a surface of 20 square inches, under which are placed sixteen layers of lint, saturated with a warm 2 per cent. solution of potassium iodide. A current, controlled by a suitable rheostat, with a milli-ampèremeter in circuit, is passed through the plates, which, beginning at zero, is gradually increased to 100 ma. and at the end of half an hour is gradually withdrawn. The best results were obtained when intervals of four to seven days were allowed, and in subsequent ionizations the positions of the plates are so altered that in each ionization the current is directed from a different point through the affected parts. When the disease is extensive, the whole pulmonary surface is gone over and the most seriously affected parts repeatedly ionized. By this method, ionization takes place from the potassium iodide introduced into the blood, through the walls of the blood-vessels into the tissues, as well as from the lint outside the skin. Curle (Pract., Dec., 1912).

In so-called "**scrofulosis**," iodine fulfills a useful purpose. Lugol, who did much to show its merits in this class of cases, is said to have obtained a large proportion of recoveries by means of the solution bearing his name, as far back as 1828. Bazin recommended it especially in early manifestations, before the cervical glands were greatly enlarged and

ulceration near at hand. In the **peri-bronchial glandular enlargements** often encountered in scrofulous children, the exhibition of iodine is frequently attended with considerable benefit. The syrup of the iodide of iron, given in 5-drop doses three times daily, is especially valuable in this connection. As a matter of fact, all scrofulous glandular swellings, joint enlargements and osseous disorders are beneficially influenced by iodine used simultaneously by mouth and externally. Spolverini has even recommended intravenous injections of iodine in cases of scrofulotuberculosis and **syphilis** in infants. He uses a solution containing 1 Gm. (15 grains) of iodine and 3 Gm. (45 grains) of potassium iodide in 100 Gm. (3½ ounces) of distilled water. The maximum dose is 5 c.c. (1¼ fluidrams).

Twenty cases of **osseous tuberculosis** in children treated by Durant's method of injecting an iodide solution of iodine. Careful examination of the blood was made before the treatment was started, and then again after about thirty injections of 1 c.c. (16 minims) had been given. All the cases were considerably improved and suffered no inconvenience. A marked increase in the number of red corpuscles and in the hemoglobin and globulin index was noted. In 14 out of the 20 cases there was an increase in the white corpuscles. The mononucleated leucocytes (especially the small ones) were increased. This leucocytosis would strengthen the phagocytic powers of the cells of the body, and hence increase the resisting power of the organism to the tubercle bacilli. Gianasso (*Riforma Medica*, May 27, 1905).

In **surgical tuberculous disease**, the author's *modus operandi* is as follows: Operate and scrape as usual. Then thoroughly swab the cavity

with iodine liniment (B. P.). A piece of cotton-wool twisted around the end of a probe forms a good swab. The liniment is applied every day. The application does not cause pain, except momentarily. Granulations do not become excessive. At the first application a thin piece of gauze is packed in lightly, but never at subsequent dressings. From the first there is given internally a mixture containing syrup. ferri iod. (B. P.), 1 dram (4 c.c.), and potassium iodide, 5 grains (0.3 Gm.), thrice a day. Tatchell (*Brit. Med. Jour.*, Feb. 13, 1909).

In **chronic pleurisy** and **empyema** good results have followed injection of undiluted tincture of iodine into the serous cavity after evacuation, or daily irrigation of the cavity with a solution consisting of 6 grains (0.4 Gm.) each of iodine and potassium iodide in 1 pint (500 c.c.) of water. The liniment of iodine is also applied to the chest as a counterirritant in chronic pleurisy, to promote absorption of the accumulated fluid.

In **rheumatism** potassium iodide is a valuable remedy in the subacute and chronic forms of the affection. To give it during the acute or inflammatory stage is worse than useless. It may be used, however, in rheumatic pains devoid of inflammatory manifestations, such as lumbago, sciatica, and neuralgia following exposure. Its efficiency is greatly increased by the addition of colchicum. The following formula for such a combination can be recommended:—

R Potassium iodide ʒij (8 Gm.).

Water, enough to dissolve the iodide.

Then add

Tincture of colchicum-

seed ʒiiss (10 c.c.).

Syrup of orange-peel,

enough to make ʒiij (90 c.c.).

M. Sig.: One teaspoonful every three hours.

Combined administration of the iodide with sodium salicylate is advised by Burnet, on the ground that while the latter causes elimination of uric acid, the iodide prevents uric acid from combining with alkali in the blood. Small doses of potassium iodide—5 to 10 grains (0.3 to 0.6 Gm.) thrice daily—are sufficient in chronic rheumatism.

Report of a case in which only 5-grain (0.3 Gm.) doses of potassium iodide, taken at intervals of thirty-six to forty hours, sufficed to relieve **gouty pains**. A faint indication of the presence of the iodine in the urine was given in twelve minutes, and a very decided one in twenty-four minutes. The reaction was observable without any repetition of the dose for the whole of the next and part of the third day, when it disappeared first from the urine and a few hours later from the saliva. This order was always observed whether the drug was taken by the mouth or introduced into the rectum. No trace of iodide was ever found in the feces.

When hydriodic acid was substituted for KI, absorption was effected in about the same time, while elimination was much more rapid, the drug being scarcely observable in the urine after six hours, though it could be detected in the saliva several hours later. William Carter (Liverpool Medico-Chir. Jour., July, 1906).

Subcutaneous injections of a dose not exceeding 0.02 Gm. ($\frac{1}{2}$ grain) of pure, desiccated sodium iodide, while without any action under normal conditions, are very effective in relieving **pain** of various sorts, as well as vascular or bronchial spasmodic conditions. This applies to **intercostal neuralgia** and the **neuralgia accompanying grippe**, the initial pain in **pleurisy** and **pneumonia**, **lumbago**, **sciatica**, certain forms of **headache**, and the pain arising from **sinusitis** and **iritis**. The measure sometimes proved effective in **cardiac palpita-**

tion, the **dyspnea of asthma** and **emphysema**, **acute pulmonary edema**, **post-traumatic vertigo**, and conditions resembling **angina pectoris**. The most marked evidence of the sedative effect of the iodide was seen in cases of **acute tenosynovitis**, **anal abscess**, **quinsy**, and **mammary abscess**, in which the pain was so obtunded as to permit of sleep on the following night. In a few cases a febricula was observed to follow the injection of iodide. J. L. Champion (Presse méd., Dec. 18, 1912).

Local application of iodine over painful areas in chronic rheumatism, the surfaces being then covered with cotton wadding, is of great assistance in affording relief and accelerating recovery.

In **acute articular rheumatism** it is the author's practice to apply an iodine plaster to the affected joint. A piece of zinc oxide adhesive plaster about 6 by 8 inches has a thin layer of absorbent cotton or lint spread on the sticky side, leaving a margin uncovered about $1\frac{1}{2}$ inches wide all around. The cotton is moistened with tincture of iodine, tincture of belladonna, and spirit of camphor, equal parts. The plaster is warmed, applied, and covered with flannel. If the pain is not controlled in twenty-four hours, one edge of the plaster is raised and more of the solution poured in, covering the leak with a fresh piece of plaster. Mercury is pushed internally and also a little acetanilide and salol given. Morphine is very seldom needed where this treatment is begun early. Even in **sciatica** these measures have given better results than any other treatment. Stabler (Med. News, June 25, 1904).

In **simple hypertrophic goiter**, iodine or iodides, given very early in the course of thyroid enlargement and in small doses, are sometimes productive of good results, though often, again, their administration

proves a failure. In cystic goiter, or where the thyroid is the seat of a benign or malignant neoplasm, however, iodine is not to be used. Injection of iodine tincture in doses of 5 to 15 or more minims (0.3 to 1 c.c.) into the substance of the goiter is a measure frequently availed of with benefit in the simple hypertrophic variety of thyroid enlargement.

In **exophthalmic goiter**, or Graves's disease, the use of iodine has proven advantageous in a certain proportion of cases. It is indicated more especially in the early stage of the affection. McGuire has reported, however, good results from the use of iodine by cataphoresis in a case with severe subjective symptoms. Ten to 15 drops of the tincture were administered daily for two periods of three weeks, separated by an interval of like duration. The gland was reduced to one-fifth its original size, and all the subjective symptoms relieved. Two other similar cases were treated with the same results, and in 4 cases of recent simple thyroid hypertrophy the enlargement rapidly disappeared under the same measure.

Among skin disorders, **erysipelas** in its early stages may be advantageously treated and even aborted by the application of iodine. Mario treated 40 cases with success by dipping a sterile swab in fresh 10 to 12 per cent. tincture of iodine and lightly painting over the surrounding healthy skin, then painting with another similarly prepared swab over the diseased area, and covering the whole with sterile wool; this was repeated as often as five or six times a day.

In **acne**, **psoriasis**, **pityriasis**, **tinea**, and **lupus**, iodides taken internally are frequently beneficial. For **tinea**

tonsurans a combination of iodine with oil of wood-tar has been advised for external application, while in certain cases of **seborrhea** the local use of the tincture of iodine has been found particularly valuable. In **scleroderma** the use of an ointment containing iodine sometimes yields favorable results.

To prevent **pitting in small-pox** Rockhill has found iodine very efficacious. Upon painting over the individual pustules a 10 per cent. iodine and 90 per cent. glycerin mixture, the lesions dry up and the customary destruction of tissue and disfigurement are avoided. Pustules upon the face should be opened with a sterile instrument and then touched with iodine tincture.

Vomiting is a symptom sometimes amenable to small doses of iodine. For vomiting in uremia, 1 to 3 drops of iodine tincture may with advantage be administered in ice-water or in cold milk.

Externally, tincture of iodine is extensively used as a counterirritant. As such it may be said to have become a household remedy, and to be more or less beneficial in almost all painful ailments—including, *e.g.*, **chilblains**,—except where abrasions are present. When burning and itching are experienced, iodine applications should be discontinued until these symptoms disappear. As a rule, the surface covered by tincture of iodine should not exceed that represented by the two hands, lest manifest poisoning through absorption occur. Linossier and Lannois have pointed out the fact that absorption of iodine through the skin becomes much more active when the part to which it is applied is hermetically covered.

Such absorption is too irregular in rate, however, to render iodine painting useful for systemic iodine treatment.

Iversen finds that the topical application of iodine can be executed without the patient's experiencing a smarting sensation by taking a piece of gutta-percha tissue, applying to it three or more coatings of tincture of iodine, then drying it, placing it over the selected locality, with the iodine coating turned downward, and securing it with a roller bandage.

As **surgical antiseptic**, *i.e.*, for the disinfection of the field of operation, iodine has proven extremely effectual, and may, in fact, be considered the method of choice because its use occupies the least time and is the least burdensome to the patient. It is the equal of any other agent in efficiency, and its action consists probably not only in destroying germs in the superficial layers and in some measure at least, in the deeper layers of the skin, but in inducing a surface hyperemia favorable to local defensive processes, including phagocytosis. An essential precaution in the use of iodine is to avoid all preliminary washing of the skin that will prevent the latter from being absolutely dry when the iodine is applied, as any moisture at the surface will not only, by causing the inter-cellular spaces to swell, prevent a thorough impregnation with the germicidal agent, but will tend to bring on a subsequent iodine dermatitis. Patients may be bathed the day before the operation, where this is practicable, but in emergency cases ether or alcohol alone should be used for cleansing purposes before the iodine is applied.

The author agrees with Grossich and Walther that tincture of iodine is the best skin disinfectant known. Both these authors performed experiments which clearly demonstrated that iodine has the power of penetrating deeply into the layers of skin. The spaces between these layers are occupied by the various forms of bacteria, fat, sweat, etc. The inter- and intra-cellular capillary and lymph-spaces all communicate with these layers of epithelium, and it has been conclusively shown that iodine penetrates into all of these various clefts and openings of the skin. The alcohol of the tincture dissolves the fat, while iodine has a special penetrative quality of its own and forms a chemical combination with the fatty acids of the skin, which combination is quickly absorbed. Soap and water cleansing is wrong in principle, as the intra-cellular spaces are filled with the soap solution, which prevents the action of the alcohol. I. S. Stone (*So. Med. Jour.*, Jan., 1910).

Weak dilutions of iodine, even to 5 per cent. of the official tincture, thoroughly sterilize the surface of the skin after from two to fifteen minutes. While the inhibitive action of absolute alcohol is quite potent, this property is greatly enhanced by the addition of iodine to an equivalent of 5 per cent. of the U. S. P. tincture. Tincture of iodine diluted with an equal amount of absolute alcohol is reliable as a local application in preparation of the skin or mucosa in any part of the body. Dilutions of less strength are unreliable if hairs or large hair-follicles are in the field of operation. The 50 per cent. dilution, if not carelessly applied, is not likely to injure the skin. Bovée (*Amer. Jour. of Obstet.*, July, 1911).

Although at first it was thought necessary to employ the tincture of iodine in full strength, further experience seemed to show that a 25 per cent. dilution of this tincture, that is, one made by adding 1 part of it to

3 parts of alcohol, thus containing a little less than 2 per cent. of iodine (the tincture containing 7 per cent.), is equally efficient, while possessing the advantages of not endangering the skin of patients very sensitive to iodine and of less expense.

By some, however, a 50 per cent. dilution or the pure tincture is used, and Sabbatani has shown that all irritation of the skin can be avoided by removing the excess of iodine, after its purpose has been accomplished, by swabbing the skin five or ten minutes after its application with a tepid sterilized 5 per cent. solution of sodium thiosulphate (hyposulphite), followed by the application of a layer of cotton, to be lightly pressed down and removed in a few minutes. With this procedure, moreover, discoloration of the skin from the iodine is almost entirely avoided.

The untoward effects sometimes observed with the tincture of iodine method of surgical sterilization are due to the medium in which it is dissolved or to its spoiling. The author applies the iodine in the form of vapor; for this he has devised a convenient little apparatus. The iodine by this method simultaneously sterilizes, induces active hyperemia, and stimulates the tissues to rapid repair. Jungengel (*Münch. med. Woch.*, March 22, 1910).

Very satisfactory results in the avoidance of skin infection reported from disinfection by washing the skin with ether, followed by a single painting with a 5 per cent. tincture of iodine. The skin is gently rubbed with cotton tampons soaked in ether until it seems clean. Iodine is then applied and the part is allowed to dry. Even in earliest infancy this preparation causes no irritation of the skin, though very efficacious. Marique (*Jour. méd. de Bruxelles*, April 14, 1910).

When an operator violates his aseptic technique, he may restore asepsis by immersion of the hands in tincture of iodine mixed with an equal part of alcohol, and subsequent dipping of them in a 10 per cent. sodium hyposulphite solution. Chabanier (*Presse méd.*, Aug. 10, 1912).

In the process of sterilization by iodine, the latter is simply applied to the skin upon the operative field during the induction of anesthesia. Five minutes at least—preferably eight, but not necessarily any longer—should elapse after the application of the tincture before the incision is made.

Dry shaving before the operation should alone be practised. Any additional incision required during the period of anesthesia necessitates only painting the part with the tincture, without endangering the wound already made, or the viscera, if exposed (I. S. Stone). According to Shanz, the line of cicatricial union is narrower after iodine than after other methods of sterilization. Repeated further applications of iodine after the operation were made by Alcock, but these have been shown to be unnecessary.

The author first cleanses the field of operation with 1 per 1000 iodized benzin. This takes the place of the usual scrubbing with soap. The operator himself does or supervises the sterilization, which is complete in four or five minutes as the benzin evaporates so rapidly. He applies the benzin for one or two minutes, mopping with two or three wads of cotton. The tincture of iodine is then applied with a small wad of cotton with which he first presses down the skin to form a depression into which the tincture is poured and then mopped over the desired area. This is repeated several times. A. Bogdan (*Zentralbl. f. Chir.*, Jan. 15, 1910).

Report of experience comprising 300 aseptic operations under the use of iodine disinfection. It is necessary to avoid the application of adhesive plaster to the area brushed with iodine, and the procedure should be repeated with every change of dressing. In little children it is well to wipe off the iodine at once with a sterile pledget. The vagina, mouth, and nose could be effectively disinfected with iodine, and in **intestinal resections, enteroanastomoses, and appendicitis operations** its application to the intestinal mucosa was unattended with any deleterious effects. Tincture of iodine is much safer than iodoform-glycerin in the treatment of **surgical tuberculosis**. In the management of accidental **wounds** it is possible by its use to annihilate all germs, even the organism of tetanus, provided it is employed early. A. Hofmann (Münch. med. Woch., Nu. 3, 1911).

As a substitute for tincture of iodine in skin disinfection the author recommends a 2 per cent. solution of iodine in carbon tetrachloride. The latter is a heavy anesthetic fluid, dissolves fat readily, does not burn or explode, is moderately antiseptic, and is cheap. The author has used this solution in abdominal work for the past three years and has never noticed any skin suppuration or irritation. The abdomen is shaved the night before operation, washed with gauze, and an antiseptic soap. At the operating table, the solution is swabbed on the skin and rubbed into the surface with a piece of gauze for between one and two minutes. The mixture dries readily, leaving the skin ready for incision. Ellice McDonald (Med. Record, April 25, 1911).

The increase in the number of cases of intestinal obstruction noted by the author since the introduction of the iodine method of disinfecting the field of operation suggested that the iodine might be responsible by causing adhesions. When iodine is used to disinfect the field for a laparotomy, the intestines must be

protected from possible contact with it. Propping (Zentralbl. f. Chir., May 13, 1911).

One can begin an operation two minutes after a single painting with iodine. The second application of iodine tincture is not absolutely necessary, as the number of germs is but very little further diminished. Of greater importance is it that the first application be energetically made. Complete eradication of bacteria in the skin is not accomplished. The method is not suitable in some cases, as in Basedow's disease and in Thiersch skin grafting, when, if iodine is used, the grafts will not hold. Noguchi (Archiv f. klin. Chir., Bd. xevi, H. 2, 1912).

Treatment of operation areas by tincture of iodine, applied at intervals for the first few days, the incision being left exposed to the air, and only covered by clean night-clothes advocated. The aim in the treatment of a wound is to let it be hermetically sealed against the entrance of outside organisms by its own dried secreted serum, and then to render this sterile to growth of the bacteria, if they should escape from the infected sweat glands. If a wound is observed two days after operation, it is often seen to have raised and slightly inflamed edges, but with an iodine dressing the wound is seen to be flat with the surface and no surrounding swelling or redness. The tincture is only painted on for the first three days and again on the removal of the stitches on the ninth day.

The method is applicable only to those cases in which the wound can be completely closed up. In all operations in which support is afterward necessary, it cannot be used, as in amputations, excisions, etc. In abdominal operations it has been perfectly successful.

All the bleeding points in the incision are to be stopped during the operation, and the wound kept dry; no wet swabs are to be used, and only that blood to be removed which

comes away with dry swabs or with the iodine-covered swab. The wound layers and the skin edges must be brought into very close apposition, and each layer is to be united separately. Iodine is then to be applied immediately after the operation and again in three hours. In the case of wounds which need some support, a sterile towel may be placed over the wound and some supporting straps of adhesive plaster used. When the perineum is the site of the operation the iodine is to be applied after each act of micturition, and the legs are to be kept apart to prevent sweating. Alcock (*Brit. Med. Jour.*, Feb. 3, 1912).

Application of tincture of iodine to intestinal tract, when the latter has been opened, has a favorable effect upon healing, and reduces the danger of postoperative peritoneal infection to a minimum. The author employs a 5 per cent. solution. When there is a thick layer of mucus on the gastric mucosa, it is wiped dry, and the iodine applied vigorously. In the large intestine the contents are also carefully wiped away with pads before applying the iodine. In cases in which the abdomen was opened later by operation, or autopsy, the field of operation was faultless. Payr (*Zentralbl. f. Chir.*, March 23, 1912).

In cases in which the use of a hot, wet dressing after an operation is contemplated, the employment of the iodine is fraught with danger, as under these circumstances there is considerable probability of a severe dermatitis developing even if the iodine has apparently been thoroughly washed off with alcohol before the dressings are applied. (*Wisconsin Med. Jour.*, April, 1912.)

In a series of 225 operations performed using the Grossich-Brunn method of iodine disinfection of the skin under unfavorable conditions, the author had only 4 cases of suppuration, or 1.7 per cent., while in 90 operations in which the older methods were employed, suppuration occurred in 15 cases, or 16.7 per cent. Pav-

lovsky (*Roussky Vrach*, June 9, 1913).

Iodine painting is superior as a skin disinfectant to "scrubbing up." The official U. S. P. tincture (7 per cent., or half that strength) may be used. Before painting the skin, moisture should be removed with benzin, alcohol, or ether. Iodine dermatitis may occur in those individuals who show an abnormal susceptibility to that drug. This can be prevented in most cases by using the iodine only once and in a single coat, and by washing off the skin, after the operation, with alcohol. Iodine skin sterilization is inadvisable in hyperthyroidism, in individuals with a sensitive skin, on the face, and on the genitalia. W. M. Brickner (*Amer. Jour. of Surg.*, Oct., 1912).

Though tincture of iodine is effective as a means of sterilizing the skin, it has its disadvantages. Should the intestines come into contact with it, adhesions will undoubtedly take place in the area exposed, due to its action as an irritant to the peritoneum; when tincture of iodine is used as a means of preparing the field, the utmost care should be taken to avoid such contact by protecting the field beyond the abdominal incision by means of moist pads securely fixed in place, and under no circumstances should iodine or its tincture be poured into the peritoneal cavity. Frank (*Amer. Jour. of Obstet.*, Nov., 1913).

In major operations the writer favors the use of iodine as an internal disinfectant. It is microbicide and antitoxic, stimulates the production of leucocytes and the functions of the glands, especially ductless glands, and tones up the vital functions in general. In typhoid, puerperal sepsis, epidemic meningitis, measles, scarlet fever, and whooping-cough it aids in subduing the infection and reducing contagiousness, and seems to ward off complications. Small frequent doses must be used, kept up day and night. In whooping-cough he gives 7-year-old children 60 drops of the French tincture in 24 hours. In tuber-

culosis it should be pushed to the limit of tolerance, beginning with minute doses. L. Boudreau (*Jour. de méd. de Bordeaux*, Jan., 1916).

Before gynecological operations skin disinfection with tincture of iodine has become a regular procedure, and the agent is also applied with success to the vagina before operations on this part. The vaginal walls may be held apart by specula, swabbed thoroughly with ether, and then with tincture of iodine. Care must be taken subsequently not to allow any of the iodine to remain in the vagina (Boyd). In certain cases, such as those of uterine prolapse, owing to the great difficulty in securing an aseptic operative field, Stone has the work of sterilization commenced on the preceding day, and iodine applied a second time just before the intervention.

The tincture of iodine method as a preliminary to obstetric maneuvers has fulfilled all expectations. After the vulva and vicinity have been wiped dry tincture of iodine is applied from the pubis to beyond the anus and past the tuberosity of the ischium on each side. Smarting (in women not under an anesthetic) lasted less than a minute. H. H. Schmid (*Zentralbl. f. Gynäk.*, June 24, 1911).

Tincture of iodine rarely causes irritation of the surgeon's hands. It can be removed from the latter by means of boiled or raw starch, ammonia water or the aromatic spirit of ammonia, sodium hyposulphite, hydrogen peroxide, Fowler's solution, or ether. Where long periods of operating are expected it is advisable to dip the hands in iodine, at once decolorize with ammonia, then slip on rubber finger cots, and redip in the iodine (Woodbury). Con-

tinued contact of iodine with instruments tarnishes and affects their cutting edges; the customary preparation by boiling is, therefore, preferable.

The author's method of **preparation of catgut** is as follows: The raw strands are immersed in a watery solution of 1 per cent. iodine and 1 per cent. potassium iodide crystals, allowed to remain for eight days, and then transferred to a dry sterile jar covered with gauze. The result is that the catgut is antiseptic as well as aseptic, it absolutely cannot be infected, its tensile strength and pliability are increased, and it is exceedingly cheap. Dannreuther (*Med. Record*, Jan. 16, 1909).

Iodine is decolorized in several ways: by the use of any of the alkalis, by phenol, by sodium thiosulphate, and by sodium sulphite, but in every one of these methods the iodine enters into combination, and thereby loses all or the greater part of the antiseptic power for which it is chiefly employed. The "colorless iodines" are useless for sterilizing the skin. Willmott Evans (*Lancet*, Jan. 7, 1911).

A chemical change rapidly takes place between sodium thiosulphate and iodine, the two chemicals blending to form sodium iodide and tetrathionate, which are both very soluble and readily wash off the skin and tissues. Snoy (*Deut. med. Woch.*, Jan. 26, 1911).

Catgut can be made aseptic through immersion in 5 per cent. alcoholic tincture of iodine or in a 1 per cent. aqueous solution of potassium iodide and tincture of iodine. The strength of the catgut does not suffer if the material is left for five days in the solution. It is of importance to use only catgut freshly immersed in tincture of iodine. Hoffmann and Budde (*Deut. med. Woch.*, March 28, 1912).

A solution consisting of iodine and alcohol alone rapidly deteriorates, with the development of the irritating hydriodic acid. If such a solution is

to be used in skin disinfection, therefore, instead of the official tincture containing potassium iodide, it must have been one prepared immediately beforehand. It may prove convenient to carry in a tightly stoppered vial 40 grains (2.5 Gm.) of iodine, to which, when required for use, 1 ounce (30 c.c.) of alcohol can be added, making approximately a 10 per cent. tincture.

The era of iodine as an antiseptic and disinfectant for **wounds** began with the observations of Grossich in 1908, though Carl Beck, in 1901, had already pointed out the value of the method and shown that no bacterial cultures could be obtained from areas thus treated. Accidental wounds rich in bacteria heal by first intention when their immediate vicinity is painted with the tincture.

In traumatic surgery tincture of iodine appears to the author to be the best of all antiseptics. In treating with it nearly 1000 patients with incised, lacerated, and contused **wounds, dog-bites, compound fractures, traumatic amputations**, etc., he has obtained excellent results. The more simple the technique, the better. T. G. Orr (Jour. Mo. State Med. Assoc., May, 1913).

Nascent iodine vapor for **sluggish wounds**, combining a thermocautery bulb apparatus with Jarret's urethral cannula and a small quantity of iodoform and a few particles of pure iodine, is used by the writer. The wound is first carefully treated with moist, aseptic dressings. A dry superficial layer forms under which healing rapidly progresses. Quinsac (Presse méd., May 13, 1918).

The technique for the use of iodine in lacerated or other wounds such as often arise in those engaged in industrial or agricultural occupations is described by Réclus as follows: With a gauze sponge held in forceps

and dipped in tincture of iodine, every recess of the wound should be coated with the tincture. Every crevice must be reached, even at the expense of enlarging the wound, if necessary. Next the surrounding skin is treated in the same way. Any excess of iodine may then be washed away with alcohol. The latter is then allowed to evaporate and as soon as the surface is dry, the wound covered with an aseptic pad and a layer of absorbent cotton, held in place by a light bandage. In twenty-four hours the dressing should be removed, iodine again applied to all recesses of the wound, and after drying, gauze and cotton again applied. This may be repeated daily until all oozing ceases, when the dressing need only be changed every three to five days. Where secretions collect under loosened skin or crusts, the latter should be removed and iodine applied. With this treatment preliminary preparation of the wound by washing and scrubbing is both unnecessary and prejudicial. It is merely necessary to dry the wound carefully before applying the iodine and, perhaps, to trim away skin or other tissues the vitality of which is plainly destroyed. The efficiency of this procedure, notwithstanding its simplicity, has proven far greater than that of the older methods of time-consuming cleansing and antisepsis, healing taking place with great readiness and with minimum loss of tissue. In all **crushes** of extremities and **compound fractures** Réclus highly recommends the employment of iodine. Stone considers a 25 per cent. dilution of the iodine tincture sufficiently strong for ordinary purposes in emergency cases.

The filthiest **wounds** may be cleaned up with gasoline, painted over with tincture of iodine, and wrapped up in dry gauze, and the surgeon can wait the outcome with an easy mind. Jack (Washington Med. Annals, Sept., 1911).

Puncture wounds caused by nails, etc., should be treated by enlarging the opening through the skin, cleaning out the wound with a small ear curette and introducing a narrow strip of gauze twisted and dipped in iodine. C. F. Nieder (N. Y. State Jour. of Med., April, 1911).

Alcohol to which crystals of iodine in excess have been added, "10 per cent. tincture of iodine," is an ideal and powerful counterirritant. Iodine hydrate (4 per cent.) is unrivaled for arresting **pimples, furuncles, and carbuncles**, and is a good skin antiseptic preliminary to hypodermic or intravenous medication. After application it fades quickly. Used in **wounds** it is relatively painless. Vinegar of iodotannic acid (acetum acidi iodo-tannici), made by rubbing up 1 ounce (30 c.c.) of U. S. P. tincture of iodine with 1 dram (4 Gm.) of tannic acid and 3 ounces (90 c.c.) of dilute acetic acid, acts powerfully in wounds or infected areas. It tends to harden and preserve catgut. It lends itself readily to use in the throat, vagina or urethra, though it is not a counter-irritant. In **compound fractures** and **osteomyelitis**, dilute tannin solution may be applied through a fenestra in the splint, and paraffin purple run through the overlying gauze pads, iodotannic acid being formed. Paraffin purple is made by rubbing up with a little ether, iodine and potassium iodide, of each 40 grains (2.6 Gm.), calomel, 12 grains (0.8 Gm.), and adding slowly liquid paraffin 3 ounces (90 Gm.). This procedure is effectual in **burns, cellulitis, dermatitis**, and similar conditions. D. H. Stewart (Med. Rec., Sept, 28, 1918).

Iodine is used in **local suppuration**, including **foul ulcers, inguinal adenitis, tuberculous sinuses, chancroids**

(especially when serpiginous), etc., acting as germicide and deodorant. In most cases of **scalp wound**, Pugh has succeeded in obtaining primary union by first cleansing with normal saline solution, then thoroughly drying, swabbing the wound with the tincture, and closing it completely. Similar success was often noted in inguinal adenitis upon opening up the suppurating area thoroughly, swabbing it clean with dry sponges, applying iodine carefully to every part of the wound, and where the focus was not too extensive, closing it entirely. Réclus notes the iodine tincture as having a very favorable effect in preventing the extension of a **cellulitis**.

Subcutaneous infections, such as **boils, carbuncles, phlegmons, felons**, etc., are treated with the happiest results by combining ichthyol and tincture of iodine, of each 1 part, with 6 parts of boroglyceride. The author applies them on lint or absorbent cotton, and covers with parchment paper and a bandage. Also in **erysipelas** and in **mammary inflammations**. In **local infection of the uterus occurring after abortion or parturition** this method has given excellent results. Being harmless and painless the solution may be injected into the uterine cavity. The depleting action of the glycerin is here a valuable adjunct. Where the cervix and vagina only need treatment, the patient may be trusted to make the applications herself, as but a teaspoonful of the iodine, ichthyol, and boroglyceride, injected into the vagina and left there, 2 or 3 times a day suffices. Stabler (Med. News, June 25, 1904).

In **cold abscesses** in individuals with lowered resistance, the author found a sterilized glycerin or olive-oil emulsion of iodoform of great value. In **suppurative arthritis**, abscess cavities, and **empyema**, he used iodine in 1:1000 strength. For hand

disinfection he advises: Iodine, 2.5 Gm. (38 grains); potassium or sodium iodide, 5.5 Gm. (85 grains); water 250 c.c. ($\frac{1}{2}$ pint). This gives a 1:100 solution, which can be readily diluted as desired. Cannaday (Jour. Amer. Med. Assoc., April 14, 1906).

The author fills **abscess** cavities or **suppurating ulcers** with a 5 per cent. solution of iodine in ether, and finds that after the ether has evaporated the wall is covered with a thick layer of pure iodine. One application is ordinarily sufficient. The same treatment is adapted to **chronic fistulas**. If preferred, 10 per cent. iodine in petrolatum may be substituted, or gauze may be soaked in a 10 per cent. solution in ether and the cavity filled with it. Isambert (Gaz. des hôpitaux, 110, 1906).

In case of acute spreading **gangrene** starting from a puncture of a hematocle, and which had invaded the belly wall, the thorax, and formed tympanic pockets in the armpits, the author opened the major focus of infection with a thermocautery, evacuating gas which burst into flame. Iodine was applied thoroughly to the cavity and the patient recovered. Réclus (Presse méd., No. 13, 1911).

In the **skin infections** often seen in threshers, corn huskers, harvest hands and others, in which one center of infection, boil or abscess, is followed by a crop of others within a limited zone, the author knows of no treatment superior to lancing the abscess, opening the little yellow pimples, absorbing the contents with gauze, and applying iodine to the whole area, followed by a light dressing. F. A. Long (Western Med. Rev., Oct., 1912).

In various forms of mucous-membrane infection, iodine has proven immensely helpful. In ophthalmology it is frequently employed in the treatment of **trachoma**, and according to Woodbury can be used in a dilute preparation in ordinary forms of **conjunctivitis**.

Potassium iodide used locally in various ophthalmic lesions, **infantile cataract**, **episcleritis**, **scleritis**, and **iridocyclitis**. In all cases considerable improvement was shown after the first day and cure followed after varying periods of time. In **rheumatic** and **arthritic lesions** the treatment is especially applicable. The iodide is employed in strengths of from 1 to 2.5 per cent. From 2 to 3 drops are instilled into the eye from one to three times a day. The procedure is painless and provokes no reaction. Severe cases might be benefited by subconjunctival injections of the solution. A. Leprince (Revue française de méd. et de chir., No. 57, p. 1361, 1903).

Iodine used in an ointment, with an anesthetic, as a **disinfectant of the cornea**, notably after the extraction of foreign bodies. The formula is: *Storaine*, 0.15 Gm. ($\frac{2}{4}$ grains), finely pulverized and dissolved in 5 drops of oil. Add, after mixing, preferably on a water-bath:—

Hydrated wool-

fat 5 Gm. (75 gr.).

Petrolatum 10 Gm. ($\frac{2}{2}$ dr.).

Add gradually the following solution:—

Iodine 0.15 Gm. ($\frac{2}{4}$ gr.).

Sodium iodide . 0.30 Gm. (4½ gr.).

Water 1½ Gm. (24 min.).

Dewaele (Trans. Belgium Ophthal. Soc.; Ophthalmology, Jan., 1913).

Tincture of iodine is invaluable as an antiseptic in ophthalmology. There is no risk, as the tissues of the eye bear it perfectly. One or two drops of cocaine should be instilled beforehand to avoid pain, and the iodine applied directly to the seat of injury by means of a cotton pledget. It is particularly valuable in **affections of the lids**, in **corneal ulcers**, and for preoperative and postoperative work on the eyeball. Many cases of injuries which are ordinarily sent to the specialist could be successfully treated by the general practitioner by the application of tincture of iodine. The author has thus

used it in 37 **cataract** operations, among others. Jacqueau (Lyon méd., April 27, 1913).

The writer emphasizes the absence of caustic action when tincture of iodine is applied to the eye. He has used it in 107 **cataract** operations without iridectomy and in 74 cases with iridectomy, and all were cured in 3 days. In 4 cases of hernia of the vitreous body all were cured in 4 days. He regards it as harmless for the eyeball; no signs of irritation are apparent when the eye is dressed the next day. Even the vitreous body does not seem to be injured by it, he says, while it wards off post-operative pain and promotes rapid healing. R. Guiral (Rev. de med. y cir., Havana, Apr. 25, 1918).

In nasopharyngeal affections, and likewise lachrymal disorders, weak solutions of iodine in glycerin are of great value when gently applied night and morning with a camel's hair pencil, or pledget of cotton. Inhalations of iodine (20 minims to 1 dram of the tincture in a quart of boiling water, inhaled for five minutes at a sitting) have been used in **chronic rhinitis**, **coryza**, and **hay fever**. Hunter Mackenzie advised applications of the pure tincture, after cocaine, in atrophic disorders of the nasopharynx, and specifically in **ozena**, nasal douching with saline solution containing a few drops of the tincture has been advised. Hugh Taylor saw good results from free application of the same preparation to the throat, as well as its inhalation, in **diphtheria**, though these measures are in most instances rendered unnecessary by the use of antitoxin. In intranasal **lupus** the employment of Pfannenstiel's method, consisting in the internal administration of moderate doses of potassium iodide and liberation from it of iodine *loco dolenti*

by the insertion of cotton soaked in hydrogen dioxide solution, is asserted to yield gratifying results. In **tonsillitis** applications of the tincture are useful.

A solution of 1 teaspoonful of iodine tincture to the quart of physiological salt solution is most efficacious as an irrigation in all inflammatory and **catarrhal conditions of mucous membrane**. It can be used in the eye for the ordinary forms of **conjunctivitis** with prompt improvement. The author has also found it very efficacious in **acute urethral gonorrhea** in twice or three times this strength. When a case of **mumps** developed in a company of infantry this solution was supplied to the company to be used copiously as a gargle for several days. No other case of mumps developed. It is a routine treatment for acute throat affections.

In **tonsillitis** the tonsils are mopped once daily with the tincture; this, with Bier's treatment with a rubber bandage around the throat, has cut down the illness to an average of five days.

The saline solution will promptly abort colds when used as a spray. It is excellent in **cystitis**, acute and chronic, and catheters kept in the tincture and then transferred to this solution just before use, are sterile, non-irritant and perfectly pliable. Cases of **chancroids** with **suppurative inguinal adenitis** are hurried to convalescence by a vigorous pursuit with the tincture. **Buboes** already broken down promptly become healthy, granulating wounds. F. T. Woodbury (New York Medical Journal, Dec. 3, 1910).

In certain superficial lesions, the author gives potassium iodide by the mouth and applies the electric current to the spot; nascent iodine is generated in the lesion, exerting its therapeutic power to the full. The patient, fasting, takes 3 Gm. (45 grains) of potassium iodide. Between one and two hours afterward the electricity is applied, the positive pole

being introduced into the skin while the negative pole, wrapped in a wet pad, is held in the hand. As the iodine is generated only close to the needle, the therapeutic action is enhanced by using five needles, each 0.5 mm. in diameter, soldered to a metal plate at intervals of 0.5 mm. The process was repeated two or three times on each patch of **lupus**. This two-route method may prove a useful adjuvant to or substitute for the Finsen treatment, especially when deep action is desired. A. Reyn (Berl. klin. Woch., Oct. 16, 1911).

Cases of **severe sore throat in children** cleared up and healed in two or three days after local application of iodine that might have required a week for cure by other methods. Although pronounced burning or pain in the throat is produced by the iodine tincture, it does not last long and the good results justify the use of the remedy. Where a milder application than the tincture is desired for the throat, especially deep down in it, and in the nose, equal parts of glycerin and iodine tincture are satisfactory. This combination was used in babies only 1 year old with good results. Stress laid on prophylactic value of applications of tincture of iodine to the throat in acute contagious diseases, early in the attack and during the active stage of the affection, this measure preventing spread of the contagion to other members of the family or outsiders. H. M. Sill (N. Y. Med. Jour., Dec. 9, 1911).

Nascent iodine, liberated by the interaction of sodium iodide and hydrogen dioxide, used in aural, nasal, and laryngeal practice. After a cleansing irrigation of the parts with boiled water, 5 drops of an aseptic 3 per cent. aqueous solution of sodium iodide are instilled, followed immediately by a like amount of hydrogen dioxide solution, which is then allowed to act for ten minutes. These instillations are to be repeated daily or on alternate days. They cause a certain degree of burning, which is,

however, always bearable. In the terminal stage of **acute suppurative otitis media**, when a mucopurulent discharge persists after twenty days, notwithstanding the customary measures, each ordinary treatment should be preceded by the nascent iodine ear bath already mentioned.

In obstinate **purulent rhinitis**, as well as in **ozena**, after the parts have been cleansed with a tepid isotonic solution, a spray of a 30 per cent. solution of sodium iodide should be used, at once followed by one of hydrogen dioxide, from a different spray apparatus. About six bulbfuls of each spray should be used, and the nozzle of the apparatus at first directed horizontally to moisten the lower turbinate, then elevated at an angle in order to reach, as in **ozena**, the middle and superior turbinates. In **maxillary sinusitis** the successive use of the two solutions may also give much benefit.

In pharyngeal affections, such as **lacunar tonsillitis** and **chronic pharyngitis**, the solutions may be employed either as sprays, direct applications, or gargles. In the latter case, the patient places in a half-glassful of water 1 teaspoonful of the iodide solution flavored with mint, and in another half-glassful 1 tablespoonful of the hydrogen dioxide. Alternate gargling with the two solutions is then carried out. In any instance, the amount of iodine set free can be regulated at will by changing the concentration of the iodide solution. P. Laurens (Quinzaine therap., July 25, 1912).

In the realm of otology favorable effects have been reported by Koenig from *iodine fumigation* in **chronic otitis media**. The procedure consists merely in vaporizing iodine by heat and introducing its vapors into the ear by means of a current of warm air.

Good results reported from blowing iodine vapor into the tympanic cavity in a case of **chronic otitis**

media in which the mastoid had been opened, but discharge of thick pus continued through the meatus. The apparatus used consisted of an ordinary flat ink-bottle, provided with a perforated cork through which were passed two short glass tubes, one connected with an atomizer bulb and the other leading through a rubber tube to a small, curved cannula. Before use, a small quantity of iodoform was placed in the bottle, and the tip of a thermocautery (or wire heated in a flame) brought near the iodoform to set free iodine fumes from it. E. Chapellier (*Arch. gén. de méd.*, Sept., 1912).

The action of iodine in **respiratory catarrhal conditions** is most intense when the tincture is painted on the chest near the mouth or nose, and the author, therefore, concluded that the best effects could be obtained by having the patients inhale directly the fumes of the tincture of iodine. His clinical observations have proven the value of the method. He calls especial attention to the fact that inhalation of the dry fumes of tincture of iodine is preferable to moist inhalations. The dry fumes penetrate deeper into the pulmonary air cells, leaving behind the alcoholic vapors, which are immediately taken up by the humidity of the air and eventually fixed to the mucous membranes.

In applying the measure, recently prepared tincture of iodine should be placed in a wide-mouthed bottle so that the patient's mouth and nose will not touch the glass. The inspirations, numbering from 4 to more than 8 at each sitting, must be more or less deep, according to the gravity of the case, and the inhalation repeated 5 or 7 times a day. An ordinary cold will thus be broken up in one day, but if the case should be in the nature of a **bronchial catarrh** it will take four days to cure it. If the mucous membranes are covered with a thick, mucous stratum, it is well to intensify the iodine treatment and assist expectoration by giving the usual remedies.

In children the treatment may be simplified by dropping the tincture of iodine on pieces of cotton laid on the pillow while the patient is sleeping. Staining of the pillow is avoided by placing a piece of oilcloth under the cotton. G. Torri (*Policlinico*, No. 31, 1913).

A study of the prophylactic and therapeutic use of iodine in acute infectious diseases of the upper air tract showed that iodine alone did not suffice to kill the bacteria, but that it seemed to prevent their further development. Either the nutrient medium was unfavorably affected for the growth of the bacteria or the iodine exerts a direct damaging effect on the bacteria themselves. The writer used the halogen in a 10 per cent. solution of potassium iodide [iodine, 0.3 Gm. (5 grains); potassium iodide, 3 Gm. (45 grains); distilled water, 30 Gm. (1 ounce).] For children up to 10 years of age the dose is 5 drops and for older children and adults, 8 drops. Finck (*Munch. med. Woch.*, Apr. 9, 1920).

In stomatology, iodine is used for the purpose, among others, of stimulating the gums where they tend to become retracted in the elderly. Stillé recommended, to this end, that a dilute aqueous solution of iodine (gr. j-f $\frac{5}{8}$ j) be painted on and the mouth then at once rinsed with water. In dentistry, the tincture is found useful to remove tartar from the teeth, and when evaporated to one-fourth its volume ("dental tincture of iodine") is employed as a counterirritant in cases of inflammation of the dental pulp or the pericementum, as well as to deodorize putrescent cavities in the teeth. In **pyorrhea alveolaris** Lugol's solution is frequently used.

A double decomposition of mercury and iodine compounds with the formation of nascent mercuric iodide can be utilized therapeutically in

cases of **tuberculosis of mucous membranes—buccal, laryngeal, and cystic.** Especially in **tuberculosis of the bladder**, excellent results are obtained. The patient is given a teaspoonful of a 5 per cent. solution of potassium iodide a quarter of an hour before the local treatment, which consists of the insufflation of calomel or its injection in oily emulsion. Hollander (Berlin Soc. of Med., May 16, 1906).

J. Wesley Bovée confines the treatment of **acute and chronic gonococcal infection** of the female lower generative tract to the application of iodine. If the condition, he states, can be treated before the infection has entered the uterine cavity or Bartholin's glands, it can often be eradicated by one thorough painting of the exposed areas below the uterine cavity. Where the first application fails, a second, made three days later, will commonly succeed. Some patients may be somewhat irritated by the iodine, but in the majority it may be used fearlessly about the vagina and perineum. Anything less than a 50 per cent. dilution of the tincture will only inhibit for a time, not kill, cultures. In the radical operation for **cancer of the cervix**, infection of the peritoneum as a result of rupture of the specimen during its removal is best obviated by the application of iodine to both the vagina and endometrium (preceded by galvanocauterization, with or without curetment, if excrescences or craters have been present).

Upon **vaginal discharges**, particularly those produced by the gonococcus, iodine exerts a most favorable influence. The discharge in many cases ceases after a few swabbings of the cervix. It is particularly of value in the so-called subacute stages. Iodine has also been applied to the

uterine mucosa in the early stages of **puerperal sepsis**, with excellent results. Pugh (Amer. Med., Oct. 15, 1904).

In **gonorrhea in the female**, after the patient has emptied the bladder a solution of iodine, $\frac{1}{2}$ dram (2 Gm.) of the tincture to 2 pints (1000 c.c.) of water, is injected directly into the urethra and bladder, allowed to remain a minute or two, and then voided. The process is repeated daily until edema of the vulva appears, when the injections are replaced by potassium permanganate in 1:5000 douches. One dram (4 c.c.) of tincture of iodine to 4 ounces (120 c.c.) of glycerin on a tampon is a valuable method of procuring pelvic counterirritation. After curetting for **endometritis** or **abortion** the uterus may be swabbed out with full-strength tincture, or an intra-uterine douche may be used. The author also recommends it as a prophylactic against possible **infection** and **post-partum hemorrhage**. Dannreuther (Med. Record, Jan. 25, 1908).

One of the best treatments for **gonorrheal urethritis**, acute or chronic, anterior or posterior, is a solution of iodine and potassium iodide, 1 part of each to 100 parts of water, for injection or irrigation of the urethra. In the acute cases there should usually be given internally potassium iodide and potassium bromide, 5 grains (0.3 Gm.) of each, well diluted with water, every four hours.

There is no simpler or better treatment for **furunculosis** and **carbunculo-sis** than to paint, in the early stage, externally the neighboring vascular area with iodine tincture, to inject a few drops hypodermically into the tumor masses, or to drive a solution into the swelling by cataphoresis, and then institute free purgation.

In treating **ringworm**, one may dissolve metallic iodine with alcohol and ether, add collodion and apply. A second application will seldom be needed. H. H. Stromberger (Amer. Jour. of Dermat., May, 1911).

Iodine *in statu nascendi* used as a disinfecting agent. The author first applies a few drops of a 5 per cent. solution of potassium iodide, then irrigates with a 0.1 to 1 per cent. solution of perhydrol. The disinfecting powers of the latter can be increased by adding some citric or lactic acid. Excellent results were seen in persistent subacute or chronic gonorrheal urethritis. The injections must be made before urinating and only small amounts of the iodide are to be used. Instead of the perhydrol, one may employ a solution of sodium perborate. The most brilliant results were seen in suppurating lacunæ or erosions in **subacute** or **chronic gonorrhea** of the pars anterior, the applications being made through the endoscope. Ten to fifteen minutes after the application the patient is instructed to urinate. Strong solutions may be employed in this condition without doing any harm. The treatment may also be used in **chronic endometritis** and **erosions of the cervix of gonorrheal origin**. R. Kaufman (Berl. klin. Woch., Dec. 11, 1911).

In conservative **surgery of the uterine appendages** the author uses force in applying iodine to every irregularity of the cavity of the uterus, and if possible to the tubal mucosa by way of the uterine cornua. The cervix is seized with volsellum and gently dilated. A 2-ounce glass syringe with conical nozzle about two inches in length is used to apply the iodine. About an ounce of diluted tincture of iodine (25 per cent.) is drawn into the syringe and the uterine cavity is filled and distended with all the force the syringe will permit. This pressure is continued for about two minutes.

The patient is now placed in the high pelvis position, the abdomen opened, and the examination of the annexa proceeds. If free iodine is found in the *cul-de-sac*, the excess is sponged away. Both tubes are separated and examined, and a decision is reached as to the propriety of

saving one or both of them. If even one ovary and half a tube can be retained, it is the rule to save them. The same syringe and the same or one-half strength of the tincture of iodine is then used to strongly distend the tubes with the intention of applying the iodine over the mucosa of the isthmus, if one has been unable to force the fluid into the tube from the uterus. After the irrigation of the tubes, any method of surgically conservative treatment may be practised.

The recovery of patients after this treatment is in no way unlike the usual smooth or even course which characterizes good gynecological surgery. Pregnancy occurred in 2 patients who had pus tubes treated in this manner, and a great many others are living in good health who would formerly have had both annexa removed. I. S. Stone (Va. Med. Semi-Monthly, June 7, 1912).

A 3.5 per cent. solution of iodine crystals in 95 per cent. alcohol is the weakest absolutely reliable preparation of iodine. The author recommends its use in **acute infections of the vulva, vagina, urethra, and the whole of the endometrium; acute peritoneal infections** with proper limitations; chronic conditions following infections of these structures and of the tubes, ovaries, and pelvic peritoneum; in **pelvic surgery** requiring examinations, manipulations, or operations on or through the vagina; such procedures as require opening the cervical canal or uterine cavity from either the vaginal or peritoneal side; as a routine method of preparation of the field of operation on all these structures, as well as the rectum. Iodine requires a maximum of two minutes to prepare the field of operation. J. W. Boyée (Amer. Jour. of Obstet., Feb., 1913).

In various forms of **endometritis** tincture of iodine has been applied to the uterine cavity. According to Reynès, iodine fumigations give excellent results in **ulcerative cervicitis**

and **granulomatous** or **postabortive metritis**, and are also useful in the palliative treatment of **uterine cancer**, after the superficial layers of the tumor have been scraped away. After careful swabbing the vagina and cervix this observer introduces into the former a small pledget of cotton-wool dipped in iodoform, which has been passed in the flame of an alcohol lamp, candle or match. The combustion of the cotton-wool sets the iodine free, its vapors filling the vagina previously dilated with a speculum.

Iodine is especially useful as an intra-uterine injection in **puerperal sepsis**: Iodine, 3 parts; potassium iodide, 6 parts; distilled water, to 1000 parts. When injections are not effectual, the author advocates curettage, after which the uterus is swabbed out with a bit of cotton, previously dipped in tincture of iodine. L. Ammond (*Jour. de méd. et de chir. prat.*, No. 16, p. 625, 1904).

Always use the tincture in full strength on all mucous membrane where inflammation is due to infection. All such cases should be drained with gauze. Whenever iodine in any strength is used in closed cavities, such as the urinary bladder or uterus, either thoroughly douche with saline solution and hydrogen peroxide or insert a drain—preferably a small gauze drain. Do not use a hypertonic salt solution, Wright's solution, or hydrogen peroxide for twelve to twenty-four hours after using iodine. Never use the full strength in the vagina or rectum. In all **indolent wounds** or **ulcers**, apply a bandage as nearly air-tight as possible for twelve to twenty-four hours after a thorough application of iodine. F. E. Walker (*Jour. Minn. State Med. Assoc.*, Feb. 15, 1911).

Louge's method of generating nascent iodine applied to gynecological lesions. The simplest technique for this is to dip a wad of cotton, held

with forceps, into iodoform and take up as much as it will readily hold. The cotton is then lighted and, as soon as the iodoform has burned away the tampon, sending out the amethyst vapors, is pushed deep into the vagina and held in place with a gauze or cotton plug. Or the vapors can be applied through a tube. The procedure is repeated twice a week. Reynès (*Revue prat. d'obstét. et de gynec.*, May, 1912).

Discussion of a method consisting in the heating of iodoform contained in a flask and the conduction of the iodine vapor generated through a glass tube, the distal end of which is drawn out to a fine point, and which is applied to the cavity or surface to be treated. This method is of particular value in the treatment of **infected wound and cavities** that are not readily accessible, including **tuberculous cavities** and **sinuses**, **furuncles** that have been incised, **boils**, and **chronic suppurations of the ear or mastoid**. It is also of value in **simple metritis**, **inoperable cancer**, and **puerperal infection**. In the last condition the iodine vapor is introduced into the uterine cavity by means of a double-current glass sound (iodine attacks metal). **Vari-cose ulcers** and **soft or hard chancres** are also favorably influenced. The duration of the individual treatment is three or four minutes. Louge has proposed the employment of this method in the treatment of **synovitis**, the vapor being introduced into the joint cavity by means of a syringe after the fluid has been evacuated. Boissart (*Gaz. des praticiens*; *Char-lotte Med. Jour.*, July, 1913).

In **colitis** and **dysentery**, ulcerative processes present may be favorably influenced by the introduction, after careful cleansing of the bowel by means of an enema, of 1 pint (500 c.c.) of lukewarm water to which has been added 1 fluidram (4 c.c.) of Lugol's solution. If pain is caused by this mixture, 1 dram (4 Gm.) of

potassium iodide may be substituted for the Lugol solution, or a small quantity of extract of opium added. Two injections should be given daily, night and morning, the strength of the solution being increased, if need be.

The writer recommends the internal use of tincture of iodine as an antidote against **phenol poisoning**. It has also been used with good results as an application to the skin to counteract the corrosive action of phenol. The iodine neutralizes this corrosive action on the mucous membranes of the mouth and esophagus, and is said to prevent lesions of the stomach and intestines by the probable formation of non-toxic phenol iodide. J. Maberly (Tribune méd., Jan., 1909).

Iodine administered to 44 cases of **typhoid fever**, either in the form of an aqueous solution or as the tincture, the latter in doses of 15 to 25 drops daily in a mixture of cinchon and Malaga wines or in milk. Many patients brought to the hospital in an alarming condition, with profuse diarrhea, distention or nausea, appeared to improve under the influence of the iodine. The cases thus treated usually recovered quickly; relapses were not prevented, but those which did occur were not serious. The recoveries appeared to be more numerous under the iodine treatment than among other cases. The number of deaths among the 44 iodine-treated cases was 4. M. Arnozan and J. Carles (Jour. de méd. de Bordeaux; Revue de thérap. médico-chir., March 15, 1913).

Parenchymatous injections of iodine are still employed in **hydrocele** after evacuation of the fluid, the iodine being intended to excite local inflammation, with resulting obliteration of the cavity. It has also been injected in **spina bifida**, with varying results, is not infrequently introduced

into **ovarian tumors** after their evacuation, and injected to the amount of a few minims in **enlarged tonsils** has been observed to bring about resolution. **Hydatid cysts** can be treated advantageously in the same manner.

Potassium iodide is an excellent **anti-galactagogue**.

Iodine is a potent antiseptic if applied in the form of recently generated vapor. The simplest method of generating vapors of iodine is to dust some iodoform powder upon a cotton sponge and then ignite the sponge. If larger amounts are necessary a special apparatus may be employed. The author injects the vapors once weekly into **abscesses, hydroceles, cysts, softened lymph-nodes, tumors, etc.** In **inoperable carcinoma** they dry out the suppurating surface and remove the odor. P. Louge (Gaz. des hôp., 86, 1911).

The writer gives sodium iodide intravenously. Doses of 10 or 20 Gm. (2½ to 5 drams) are tolerated by patients unable to stand the least quantity in the stomach. A 10 per cent. solution is used. He begins with 5 c.c. (75 minims), gradually increasing to 20 c.c. (5 drams), repeated daily or at longer intervals. Sodium salicylate and iodide, thus used, gave excellent result in **acute articular and muscular rheumatism** and for the pain in **chronic rheumatism** and **gout**. A little saline solution is injected between the injections of the sodium salicylate and iodide. Da Matta (Brazil-Medico, Oct. 14, 1916).

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IODOFORM.—Iodoform (*iodoformum*, U. S. P.), though spoken of by Sérullas in 1822, was first used in practice by Bouchardat in 1836. Rhigini, in 1853, brought to light its great

value as an antiseptic and as a disinfectant.

Iodoform is obtained by warming ethyl alcohol, aldehyde, acetone, or certain other organic substances with iodine and potassium hydroxide or carbonate. Its chemical composition is CHI_3 (tri-iodomethane), and it occurs in yellow crystals having a penetrating, persistent, saffron-like odor, which adheres to every object with which the drug comes into contact. This peculiar odor is one of the chief drawbacks in the use of iodoform and has greatly contributed to limit its employment.

Numerous methods for the deodorization of iodoform without impairing its therapeutic properties have been recommended, none, however, with complete success. Probably the best procedure is to mix with it cumarin, an odoriferous principle obtained from the Tonka bean—the fruit of a plant (*Dipterix odorata*) growing in Guiana. Other methods of deodorization consist in the addition of 4 drops of oil of sassafras to the ounce of iodoform (Dodsley); a few drops of oil of bitter almonds or a little musk or tar (Charteris); 1 part each of menthol and oil of lavender to 20 parts of iodoform (Cantrelli), or 1 or 2 parts of creolin to 100 parts of iodoform (von Jaksch).

To remove the odor of iodoform from the clothes or hands, washing in an aqueous solution of tannic acid is an effectual procedure. Ether or chloroform may also be used, or vinegar may be applied freely to the hands after they have been cleansed with soap and water (Ricketts). Constan states that washing the hands with orange-flower water is sufficient to dispel the odor.

Various more or less odorless substitutes for iodoform, some containing the latter in combination with other substances (vioform, iodoformogen) and others of entirely different composition (iodol, europen, aristol, airo), have been introduced.

PREPARATIONS AND DOSE.—

Iodoformum, U. S. P. (iodoform), occurring in a fine, lemon-yellow powder or in crystals, with a peculiar odor and a slightly sweetish, iodine-like taste, is soluble in 9301 parts of water, in 46.7 parts of cold alcohol, in 12 parts of boiling alcohol, in 5.2 parts of ether, and dissolves also in chloroform, benzin, and fixed and volatile oils. Iodoform is somewhat volatile, and when placed in boiling water vaporizes with the steam. It melts to form a brown liquid at 115°C . and at higher temperatures gives off vapors of iodine. Iodoform or its solutions should be kept in well-stoppered bottles in a dark and cool place. Dose, 1 to 5 grains (0.06 to 0.3 Gm.).

Unguentum iodoformi, U. S. P. (iodoform ointment), is made by incorporating 1 part of finely powdered iodoform in 9 parts of lard.

The following unofficial preparations containing iodoform are also used:—

Iodoformum aromatisatum, N. F. ("deodorized" iodoform), consists of iodoform with admixture of 4 per cent. of cumarin.

Pulvis iodoformi compositus, N. F. (compound iodoform powder; naphthalene iodoform), is a mixture of 20 parts of iodoform with 30 parts of boric acid, 50 parts of naphthalene, and 2.5 parts of oil of bergamot. Used externally.

Collodium iodoformatum, N. F. (iodoform collodion), consists of

flexible collodion in which 5 per cent. of iodoform has been dissolved.

Iodoformogen (iodoformalbumin), a nearly odorless mixture of iodoform and albumin, occurs as a fine, bulky, light-yellow powder, containing about 12 per cent. of iodine. It is insoluble in water, and can be sterilized at the boiling point of water without decomposition. Iodoform is slowly freed from the mixture when it is placed on an open tissue surface. Used externally as dusting powder.

In the local use of iodoform the powdered drug should be applied directly to the base of ulcerations and not on the surrounding skin, the object being to restrict the amount of the drug used to that which is actually necessary, in order to minimize the chances of serious iodine poisoning. Iodoform should not be sterilized by heat, but by means of mercury bichloride in 1:1000 solution. Solutions of iodoform should be kept in colorless glass bottles, to prevent iodine liberation under the influence of light. Saturated solutions of iodoform in ether, which are very unstable, readily assuming a reddish color, may be rendered more stable by the addition of alcohol as well as by protection from light. Alcohol saturated with camphor dissolves eight times as much iodoform as pure alcohol.

CONTRAINDICATIONS.—Symptoms of mercurial intoxication may result from the simultaneous use of iodoform externally and calomel or other mercurials in ordinary doses internally. Some caution is therefore necessary in the combined administration of these remedies. Some degree of danger also attends the simultaneous use of iodoform and phenol.

Iodoform had best be avoided in cases with an idiosyncrasy to iodine or iodides.

PHYSIOLOGICAL ACTION.—

Although containing about 29 parts by weight of pure iodine in 30, iodoform is rendered almost non-irritant by the combination of the carbon and hydrogen it contains with the iodine, although in a few cases with special local sensitiveness it causes evidences of irritation in the vicinity of wounds over which it has been placed. It exerts a noticeable local anesthetic action when freely applied.

Iodoform is not germicidal *per se*, but when brought into contact with moist tissue surfaces is believed to give off iodine, which is the true origin of its apparent antiseptic virtues. Iodalbuminates and di-iododi-acetylene are considered to be products of the decomposition of iodoform when placed upon the living tissues.

The general effects of iodoform, upon absorption into the system, are practically those of iodine and the iodides (*q.v.*). Indeed, iodine split off from iodoform in the presence of alkalis and of proteins forms alkaline iodides and iodalbuminates with these two classes of substances, and, being thus absorbed in the same form as is iodine, acts like the latter. It is believed by some, however, that iodoform may in part reach the blood without change and give rise directly to the cerebral symptoms sometimes seen in iodoform poisoning.

It is considered possible by many observers that in iodoform poisoning cardiac acceleration may be a result of abnormal activity of the thyroid gland brought on through the presence of additional iodine. It has been shown that iodoform may consider-

ably augment the thyroid secretion. After the absorption of iodoform, iodine may be demonstrated in small amount in the saliva, bronchial secretion, and sweat. As shown by Rummo, the elimination from the system of the iodides formed from iodoform takes place slowly, though it begins promptly after the absorption of the drug. Iodides have been detected in the urine for over a month after the absorption of iodoform.

UNTOWARD EFFECTS AND POISONING.—The local untoward effects of iodoform consist generally of an erythematous eruption. After a period of apparent perfect tolerance the wound becomes surrounded by an inflammatory area, at the circumference of which vesicles may form ("iodoformic herpes"). Petechiæ may also develop. If the use of the drug is persisted in, the lymphangitis spreads, pain is experienced locally, and signs of general intoxication appear.

Experiments in animals have shown that when used in the peritoneal cavity iodoform awakens an inflammatory process which results in an excessive formation of adhesions.

General toxic symptoms may follow the external use of iodoform without any preceding local symptoms, or may result from its use by mouth.

The usual clinical signs of systemic poisoning are, according to Chéron, a sudden rise of temperature to 102.2° or 104° F. and the appearance on the same or the following day of a skin eruption, often of an erythematous or scarlatiniform type. Itching may be present, and an eczematous type of eruption has also been reported. Anorexia, nausea, and

vomiting may appear with the eruption, or exist alone.

Another characteristic manifestation is cerebral excitement, expressed in restlessness and sleeplessness, or even actual delirium. Violent headache and giddiness may be experienced, and the taste and odor of iodoform may be noticed. The pupils are occasionally dilated, but oftener contracted and motionless (McLean). The pulse usually shows a decided increase in rate, which may soon attain 135 to 150 per minute, and is rather small and wiry. With the general discomfort experienced sometimes becomes associated mental depression, which may deepen into melancholia with hallucinations and illusions of persecution. Where this condition is marked, a period of violent mania lasting some hours or days is apt to follow. Collapse and death may occur, or permanent insanity may supervene. No other poison, according to Cushny, produces these cerebral symptoms in so marked a manner as iodoform, and no similar action has been noted in experiments on animals.

In the "syncopal or asthenic form" of iodoform poisoning (McLean) the patient is overcome with dizziness, mental confusion, and pronounced lethargy. The pulse becomes weak and rapid. Sphincter paralysis may be observed, and sudden death from heart-failure sometimes follows.

Report of a case of iodoform poisoning in a man 30 years of age after a third injection of 100 c.c. (3½ ounces) of a 10 per cent. iodoform-glycerin emulsion into a psoas abscess. The symptoms were as follows: Slight vomiting during the first day after the injections, a progressive somnolence beginning on

the ninth day, a widely disseminated acneiform eruption, desquamation of the buccal mucous membrane, crust formation in the nose, agglutination of the eyelids, followed by an increase in the reflexes of the lower extremities and stertorous respiration. Large quantities of iodoform were found in the urine. In spite of the evacuation of the iodoform emulsion by means of saline irrigation, death followed after two days. The author considered the cause of this rare symptom-complex to be the caseation of both suprarenal capsules, which was found *post mortem*. There had been no symptoms of Addison's disease. Anschütz (*Beiträge z. klin. Chir.*, Bd. xxviii, H. 1, S. 233, 1901).

The more common cutaneous conditions resulting from iodoform are general redness and swelling of the skin of the abdomen and down the thighs, sometimes extending from the trunk to the upper extremities. In several cases it has been associated with a fine, vesicular eruption, principally affecting the region of the wound. Other observers have had cases in which the vesiculation has extended into the deeper layers of the skin, resulting in considerable edema and in some instances in a sanguinolent effusion resembling superficial gangrene. The writer reports a case peculiar in that large blebs, somewhat like those of pemphigus, appeared in the neighborhood of the incision. He advises inquiry, in any abdominal or pelvic operation in which iodoform is likely to be used, whether the patient has been subject to any cutaneous affection, and, if so, to substitute another dressing for that of iodoform. McNaughton-Jones (*Medical Press*, Feb. 24, 1904).

The quantity of iodoform capable of causing death has been estimated at 1 dram, according to a case observed by Langenstein, but from other evidence it seems probable that in the majority of cases this dose

would not prove fatal. Although Czerny has reported a death after ingestion of 1½ drams, Frauenthal records the case of a woman who took 2 drams at once, with severe headache, abdominal cramps, and purging as the only resulting effects.

Fatty changes in the liver, kidneys, heart, and muscles are likely to be found after lethal iodoform poisoning. Evidences of marked gastrointestinal irritation, with degeneration of the epithelium, and extravasations of blood in the kidneys and under the endocardium may be noted. In cases of protracted iodoform intoxication in animals Koriandère noted also extreme emaciation, anemia, purulent bronchitis, rhinitis, and conjunctivitis, and an accumulation of pigment in the Malpighian bodies. Terson reported the case of a woman who, having sustained injuries of the thighs and abdomen to which iodoform dressings were applied, developed after three weeks a progressive amblyopia, accompanied by atrophy of the temporal halves of both disks.

Report of the case of a patient to whom there had been twice administered, after puncture of a psoas abscess, injections of 10 per cent. iodoform-glycerin, 300 Gm. (10 ounces) in all of this preparation having been used. Twenty-five days after the first injection and four days after the second the patient's sight became hazy, and four days later he was unable to read or write. Examination of the eye showed no change. After three weeks, improvement set in and normal vision was regained two weeks later. The case was one of toxic amblyopia, ascribable to a retrobulbar neuritis. A. Sarasoff (*Wiener klin. Woch.*, No. 47, 1907).

Some of the untoward results observed from the use of iodoform have been due to impurities. A practical

procedure for testing the purity of iodoform is to shake some of it up with distilled water, filter, and treat the liquid with an alcoholized solution of silver nitrate. If in twenty-four hours no precipitation occurs, or only a slight grayish cloudiness develops, the drug may be deemed pure.

The *diagnosis* of iodoform poisoning may be facilitated by estimating the amount of iodine which is being eliminated in the urine, as follows: A small pinch of powdered calomel is placed upon a saucer, and a few drops of the urine placed upon it. The urine and calomel are then mixed together with a glass rod. If the urine contains a notable amount of iodine there will be noticed a well-marked yellow coloration, indicating that the iodoform is being absorbed to a dangerous extent.

Treatment of Iodoform Poisoning.—Immediate removal of the drug from the surface in cases of intoxication from surgical dressings is obviously indicated. This can readily be done by means of a **warm solution of starch**, which will take up all the free iodine present. **Alcohol** or **hot water** may be used instead. According to F. E. Miller, a weak alkaline solution of **magnesia**, **sodium bicarbonate**, **lime water**, **Burow's solution** (1 to 4), or **ichthyol** (1 to 10) is useful for local application in cases of unsuspected idiosyncrasy to iodoform. Internally, 1 dram (4 c.c.) of **milk of magnesia** should be given every three hours until the bowels move, and care taken on succeeding days to keep the intestines active. In fully established cases of iodoform poisoning **potassium bromide** may be given internally to assist in counteracting the poisonous effects.

When a toxic dose of iodoform has been taken internally, the stomach should be emptied and 20 grains (1.3 Gm.) of potassium bromide given in a half-tumblerful of water. Four 10-grain (0.65 Gm.) doses should then follow at hourly intervals. The bromide not only antagonizes the cerebral excitant effects of iodoform, but is considered by some to act as a solvent and eliminant with regard to the former drug. It seems not unreasonable to suggest that, just as bromides tend to a certain extent to take the place of chlorides in the body when taken repeatedly and promote the elimination of chlorides in the urine, they may displace iodine-containing compounds from the body fluids and prevent their action.

Case of an infant for whom, after a circumcision which did not heal satisfactorily, an iodoform salve was ordered. The day after its first application the child was somnolent, with shallow breathing, and refused the breast. There was cyanosis, retraction of the epigastrium, and laryngeal spasm. The pupils were contracted to the size of pinpoints. The circumcision wound had not yet healed, but a severe eczema had been set up involving the scrotum and the inner surface of both thighs. The temperature was 100° F. (37.8° C.) and the heart's action feeble. A **hot enema** was administered with a bath, and **frictions with alcohol** and **mustard**. One-minim (0.06 c.c.) doses of tincture of **belladonna** were given every hour. The following morning the child was in a normal condition. The eczema rapidly improved. The writer especially directs attention to the apparent antidotal action of the belladonna. J. C. Josephson (Med. Record, April 14, 1900).

THERAPEUTICS.—Iodoform is not now used in surgery as much as in the last decade of the nineteenth

century, both its unpleasant odor and occasional inefficiency having been factors in causing its partial abandonment. Decomposition of the drug in contact with the tissues, with liberation of iodine, appears to be essential to its antiseptic action, and such decomposition is variable, sometimes being so slight as to preclude appreciable antisepsis, while at others it may be so pronounced as to result in iodism. Experiments with infected wounds in animals leave doubt as to the activity of iodoform. Lomry observed that, if wounds inflicted on dogs or guinea-pigs were infected with staphylococci or streptococci and then treated with iodoform, they healed more quickly and secreted less than those not thus treated. Fraenkel, on the other hand, found that iodoform caused the formation of giant cells, and that its use resulted in more exudation and more connective-tissue production than the use of other antiseptic powders, and, therefore, concluded that it was often harmful in abdominal wounds. In tuberculous conditions, on the contrary, according to this author, iodoform is useful because of this same property of favoring fibrosis—a property, by the way, which Cornil and Cowdray had already noticed and written of in 1900.

It is in the treatment of "surgical" tuberculous conditions that iodoform now finds one of its chief applications. Among the conditions that may be advantageously treated with it are **tuberculous abscesses** and **sinuses**, including those of **joint** and **bone tuberculosis**; **tuberculous adenitis**, and **tuberculous pleurisy**. In joint tuberculosis injections of a 10 per cent. suspension of iodoform in sterile

olive oil are employed. Freeman's directions for the application of this treatment may be summarized as follows: Absolute cleanliness should be observed. The iodoform should be soaked for twenty-four hours in a 1 to 1000 solution of bichloride of mercury, stirred occasionally with a glass rod to make sure that the solution touches every particle of the powder. It is next filtered, employing a filter-paper through which has been poured a quantity of boiling water. The remainder of the bichloride is then washed away with sterile water. The iodoform is removed from the filter with a surgically clean knife and rubbed up with the oil in a sterile mortar, about 4 per cent. going into solution and 6 per cent. remaining in suspension. The oil is best rendered germ-free by keeping it at the boiling-point for about half an hour. (If the mixture is kept in a dark place in a sterilized bottle stopped with germ-free cotton, it will not deteriorate for a long time.) The injections should be made both into the joint cavity and into the surrounding infected tissues. It is best to but partially withdraw the needle and insert it in a new place, rather than to make a number of punctures in the skin. If tuberculous pus is present, it should first be withdrawn. One syringeful of a 10 per cent. suspension of iodoform is an average dose. It is well to begin with a moderate quantity and watch carefully for symptoms of iodoform poisoning—which, however, seldom appear. In general, the injections can be repeated every two or three days over a period of several weeks, and then continued at intervals of a week or two.

Lucy gives the following formula

for an iodoform emulsion for injection in **tuberculous sinuses**: Iodoform, 3 parts; starch, 1 part; mix until a fine powder is obtained and add glycerin, 20 parts, and water, 12 parts. Heat gradually, stirring the mixture constantly, up to 271.4° F. The emulsion thus obtained is very stable.

The action of iodoform on tuberculous abscesses is best explained by an increased autolysis. Ordinary pus from a cold abscess will not digest a flake of fibrin or give the biuret reaction, but pus from other sources or tuberculous pus from a cavity which has been treated for some time with iodoform emulsion will readily dissolve fibrin and give a positive biuret, since there is sufficient ferment present to disintegrate the albuminous principles. This ferment is derived from the nuclei of the leucocytes. D. Heile (*Zeitsch. f. klin. Med.*, Bd. lv, 1905).

In **tuberculous laryngitis** the local use of iodoform has been followed by good results. The ulcerative surfaces having been carefully cleared of their mucopurulent discharges by a detergent spray, a solution of iodoform in ether may be directly applied at short intervals or likewise used as a spray. If very finely powdered it may be applied by means of an insufflator, to relieve the local discomfort and hoarseness.

In operations on the parietes of the mouth or pharynx, *e.g.*, in excision of the maxilla, von Bergmann highly recommends tight packing of any cavities or open wounds remaining with iodoform gauze. After 159 operations of resection or excision of the tongue performed by this surgeon, with iodoform gauze packing of the wound, not one patient died from local infection. The value of

iodoform gauze for plugging the wound after rectal operations is well known. A 5-grain (0.3 Gm.) suppository of iodoform is useful in **tuberculous disease of the rectum and rectal fissures**. Where dryness of the parts is required for prolonged periods, iodoform gauze is particularly desirable.

The Mosetig-Moorhof bone-wax, employed for filling aseptic cavities in bones, consists of iodoform, 60 parts; spermaceti and oil of sesame, of each, 40 parts. For information concerning its use the reader is referred to the article on BONES, DISEASES OF.

Good results obtained in all kinds of **acute and chronic abscesses, tuberculous peritonitis, phlegmons, mastitis**, and various medical affections with effusion, by the use of a mixture of 1 part of iodoform with 10 parts of glycerin, which the author injects through a large puncture needle after withdrawing part or all of the contents of the abscess or other process. He never found it necessary to make more than three or four injections; one was generally sufficient. The method also proved effective in **inflammatory processes in the knee, acute peritonitis, polyserositis, and pleurisy with effusion**. Vandini (*Gaz. degli Ospedali*, Feb. 8, 1910).

Excellent results have in recent years been obtained in **suppurative otitis media**, disease of the **nasal accessory sinuses**, and **follicular tonsillitis** by treatment with iodine vapor set free from iodoform by the application of heat. The iodine is thus not only applied in a highly penetrating form, but probably in a nascent state, which renders it powerfully effective as an antiseptic. As suggested by F. E. Miller, the iodine vapor can be applied with a De Vilbiss metal-

tipped insufflator by heating the flexible tip for seven seconds in an alcohol or Bunsen flame; as soon as the preliminary reddish-blue vapor passes off and a greenish fluorescence appears, the insufflation should be begun. The degree of heat of the vapor can easily be tested by holding the nozzle 1 inch from the tip of the operator's tongue; a pleasant warmth and taste indicates a correct condition of the vapor for application. In the case of the ear, *e.g.*, the vapor can be blown steadily into either portal of the middle ear for about three seconds, causing a pleasant heat and soothing sensation for ten minutes thereafter, besides the therapeutic effect. According to Miller, nebulization of 3 drops of 1:1000 epinephrin hydrochloride solution in the ear previous to the vapor insufflation adds to the efficiency of the latter.

The fumes set free upon heating iodoform are less irritating than those liberated from pure iodine, as they do not tend at once to deposit in irritating crystalline particles. In treating the bladder with these fumes this organ should first be emptied through a catheter and its capacity carefully noted by introducing tepid sterile water. The apparatus used consists of a small bulb, heated by an alcohol lamp, and with which is connected a large, graduated hand syringe, for blowing out the vapor. First 0.05 to 0.1 Gm. ($\frac{1}{2}$ to 1 $\frac{1}{2}$ grains) of iodoform is placed in the bulb and the catheter adapted to an outlet from the latter. When, upon heating the bulb, violet fumes appear, the syringe is gradually emptied to an extent sufficient to fill the bladder, the capacity of which was previously ascertained. The rubber tube is then closed off, to prevent reflux of vapor into the apparatus, and the fumes allowed to act a few minutes (three, on an average) according to

individual tolerance, after which the bulb is detached from the catheter and, after the bladder has emptied itself, the catheter withdrawn. The same or even simpler apparatus may be used in treating affections of the external or middle ear, nasal cavities, or pharynx.

For intrauterine treatment, the vagina, cervix, and endometrium should first be dried, and a non-fenestrated rubber drain, sufficiently small to permit of escape of the fumes between it and the walls of the cervical canal, inserted into the uterine cavity, into which the vapor is then passed. The cervix and vagina may with advantage be given the treatment at the same sitting, after the endometrium.

Wounds can be treated by igniting and at once blowing out a pledget of cotton previously fixed to the end of a glass rod and rubbed lightly in iodoform. Very small areas can be given strictly local treatment by projecting the fumes on them from the small end of a funnel. In **boils** the Bier method and iodine treatment can be combined by the use of a cup filled with the iodine vapor. For the tincture of iodine local treatment in **erysipelas** and **variola**, iodine vaporization can, furthermore, be advantageously substituted.

Glass apparatus stained by the products of iodoform decomposition can be easily cleansed by means of concentrated sulphuric acid to which has been added a little chromic acid, potassium dichromate, or potassium permanganate. G. Meillère (*Tribune méd.*, March, 1913).

Iodine vapor can readily be set free from iodoform by heating the latter with the electric cautery. The author has had constructed a simple insufflator consisting of a small glass bottle, a rubber bulb and tube, and an ordinary electrocautery, the platinum extremity of the latter dipping down to the bottom of the bottle, while a convenient handle is attached to its other extremity. The whole apparatus, which is rather

light, is held by the operator by this handle, his other hand (or an assistant) manipulating the rubber bulb. The outlet for the iodine vapor is conical, so that a number of differently shaped and curved attachments can readily be adapted to it. Metallic parts are reduced to a minimum to avoid oxidation, even the conical outlet being of hard rubber.

With this apparatus excellent curative results can be obtained in a variety of conditions. In **follicular tonsillitis** insufflation of a little nascent iodine vapor into the crypts through a small curved tube causes prompt recovery. After a few insufflations the crypts are completely disinfected and tend to become smaller. The entire tonsil atrophies rather easily, the necessity for its surgical removal being thereby obviated. In **maxillary or frontal sinusitis**, after either catheterization through the natural channels, intranasal puncture, or alveolar penetration, the surfaces in these sinuses can readily be covered with a deposit of iodine through an antral or frontal cannula adapted to the iodoform bottle. The fungous covering of the lining membrane subsides and the odor disappears, generally after the very first sitting. In **polypoid ethmoiditis** the iodine vapor is insufflated at the middle meatus.

Suppurative otitis media, especially in its chronic form, is greatly benefited by the treatment. With a small catheter, shaped like Hartman's cannula for irrigation of the attic, the iodine vapor can readily be introduced even into the mastoid antrum.

In **ozena** the treatment causes the odor rapidly to disappear, the secretions to become fluid, and the mucous membrane to return to its normal color. Where the membrane is in an advanced state of atrophy and paraffin injections are no longer borne, the introduction of nascent iodine vapor causes a more rapid improvement than any other measure.

The author reports two illustrative cases of obstinate **maxillary sinusitis**

and **otorrhea**, respectively, in which iodine vapor brought about prompt curative results—immediate deodorization and almost immediate arrest of secretion—where the ordinary procedures had failed. A. Maurice (*Arch. gén. de méd.*, Feb., 1914).

Treatment with nascent iodine fumes is indicated in all primary or secondary **tuberculous bladder affections**, except during acute exacerbations. The method is superior to all others for this purpose; it improves, soothes, and seems harmless. The capacity of the bladder increased in about 50 per cent. of the cases, though the incontinence did not show any improvement. In the majority of the cases the benefit was prompt and striking. The bladder need not be rinsed out beforehand unless it is much contaminated, and only plain boiled water should be used. About 0.05 or 0.1 Gm. ($\frac{3}{4}$ to $1\frac{1}{2}$ grains) of the iodoform is gently heated, and when the violet fumes issue from the tip of the cannula the alcohol lamp is set aside and the fumes are pumped into the bladder, stopping when the patient shows signs of pain or a desire to urinate. The fumes are retained in the bladder for from half a minute to two minutes. The sittings are given once or twice a week. If the iodoform is impure or impaired by exposure to the air or moisture, the nascent iodine vapor is correspondingly unreliable. Normand (*Jour. d'uro.*, March, 1914).

In ophthalmic conditions iodoform is also frequently of value. In **corneal ulcer** it may be dusted on in powder form. In **diphtheritic conjunctivitis** it may be used either as powder or in an ointment. In **catarrhal dacryocystitis** iodoform has been recommended for promoting local healing. Haab has even advised the introduction of small sterile rods of iodoform into the anterior chamber of the eye in beginning infection of

this chamber from the penetration of **foreign bodies** and in suppuration of the corneoscleral junction after **cataract extraction**.

In gynecological affections iodoform may be employed in the form of crayons, as an ointment, or in a powder, introduced with an insufflator (Montgomery). Iodine vapor set free from iodoform by heat has also been employed with good results in pelvic infections. In **erosion of the cervix** a saturated solution of iodoform in ether (1 in 6 parts) may be topically applied with advantage. In **vaginitis** the drying properties of iodoform gauze are of decided value.

Among venereal conditions in the male in which iodoform has proven useful is **chancroid**. Applied directly to the bare ulcerations, it usually exerts a decided inhibitory action on bacterial pullulation, though in a few cases irritation and inflammation may result from the drug itself. The objectionable odor can be in part disguised by adding to the iodoform oil of lavender or attar of roses in the proportion of 1 drop to 1 dram (4 Gm.), or finely powdered coffee (1 part in 5). In **chancroidal lymphadenitis** (bubo) which has gone on to pus formation the abscess should be evacuated by puncture and a 10 per cent. iodoform-glycerin emulsion injected and evacuated three times in immediate succession. If a repetition of this procedure is not followed by cessation of pus formation the abscess should be incised, curetted gently, and packed with iodoform gauze (White and Martin). Similar treatment is indicated in **suppurative gonococcal** or, more rarely, **syphilitic lymphadenitis**.

Internal use of iodoform has never

received much support. It has been tried by many in **pulmonary tuberculosis**, but the results have generally been disappointing, although Gosse's experiments showed that guinea-pigs whose system was kept saturated with iodoform could stand inoculation with tuberculous material with impunity. Likewise in **syphilis** the effects of iodoform taken internally have not, as a rule, been satisfactory.

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IPECAC.—Ipecac (ipecacuanha) is the root of the *Cephaelis ipccacuanha* (A. Richard), a small shrub indigenous to Brazil, and belonging to the *Rubiaceæ*. It is also cultivated in India. Ipecacuanha contains three alkaloids, *emetine*, *cephaeline*, *psychotrine*; a glucosid called ipecacuanhic acid, which resembles quinic and caffe-tannic acids; gum, resin, starch, a volatile oil, lignin, and sugar. The powdered root has a slight, but characteristic, nauseous taste.

The alkaloid emetine is a whitish powder, of a bitter taste, and darkening upon exposure. It is soluble in alcohol and chloroform, slightly soluble in ether, and very slightly soluble in water. It is present in the root in a proportion of somewhat less than 1 per cent. Emetine forms halogen salts and a nitrate, the acetate and sulphate being amorphous.

Cephaeline occurs as snow-white, fine, interlacing needles, which rapidly turn yellow. It is soluble in alcohol, chloroform, benzin, and slightly soluble in ether, but more soluble in boiling petroleum ether than emetine, and may be readily separated from

the latter by its solubility in sodium hydroxide solution. Its salts are amorphous.

Psychotrine is an uncrystallized alkaloid which is decomposed by light and of but little therapeutic value.

From an analysis of 145 different lots and samples of ipecac, representing in all many thousands of pounds of drug, the authors' records show that commercial ipecac averages 2.17 per cent. of total alkaloids. The average amount of emetine is to that of cephaelin as 63 is to 37. There is little or no difference in alkaloidal strength between Rio and Carthagena ipecac. Walters and Koch (Jour. Pharm. and Exper. Therap., July, 1917).

PREPARATIONS AND DOSE.—

Ipecacuanha, U. S. P. (ipecac), the dried root of ipecac, required to contain not less than 2 per cent. of alkaloids. Dose, as expectorant, 1 grain (0.06 Gm.); as emetic, 15 to 30 grains (1 to 2 Gm.); in dysentery, 30 to 60 grains (2 to 4 Gm.).

Fluidextractum ipecacuanhæ, U. S. P. (fluidextract of ipecac), required to contain 1.75 per cent. of alkaloids. Dose, as expectorant, 1 minim (0.06 c.c.); as emetic, 15 to 30 minims (1 to 2 c.c.).

Syrupus ipecacuanhæ, U. S. P. (syrup of ipecac), 100 parts of which are made from 7 parts of fluidextract of ipecac, 1 part of acetic acid, 10 parts of glycerin, and 70 parts of sugar, together with water. Dose, as expectorant, 5 to 20 minims (0.3 to 1.3 c.c.); as emetic, 2 to 8 fluidrams (8 to 30 c.c.).

Vinum ipecacuanhæ, N. F. (wine of ipecac), containing 10 per cent. each of fluidextract of ipecac and alcohol, and 80 per cent. of white wine. Dose, as expectorant, 5 to 15

minims (0.3 to 1 c.c.); as emetic, 2 to 6 fluidrams (8 to 24 c.c.).

Pulvis ipecacuanhæ et opii, U. S. P. (powder of ipecac and opium, Dover's powder), containing 10 per cent. each of ipecac and powdered opium and 80 per cent. of milk-sugar. Dose, 5 to 15 grains (0.3 to 1 Gm.).

Tinctura ipecacuanhæ et opii, U. S. P. (tincture of ipecac and opium), representing the tincture of deodorized opium, full strength (evaporated down), with 10 per cent. fluidextract of ipecac. Dose, 5 to 15 minims (0.3 to 1 c.c.).

Syrupus ipecacuanhæ et opii, N. F. (syrup of Dover's powder), each fluidram (4 c.c.) of which represents 5 grains (0.3 Gm.) of Dover's powder. Dose, 1 fluidram (4 c.c.).

Emetine hydrochloridum, U. S. P. (emetine hydrochloride), occurring as a white or slightly yellowish crystalline powder, odorless, gradually darkening on exposure to light, and freely soluble in water or alcohol. It contains variable amounts of water of crystallization. Its solution is slightly acid to litmus. Dose, $\frac{1}{4}$ to $\frac{3}{4}$ grain (0.015 to 0.045 Gm.).

Emetine, a mixture of the alkaloids of ipecac, unofficial, has occasionally been used for expectorant purposes in doses of $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001 to 0.002 Gm.), and as emetic in doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005 to 0.01 Gm.).

PHYSIOLOGICAL ACTION.—

Locally, ipecac, applied to the mucous membranes or skin, acts as an irritant. It gives rise to a papular eruption, which becomes pustular and proceeds to active ulceration if the application is persisted in.

General Effects.—*Alimentary Tract.*—Internally, small doses of ipecac frequently repeated give rise to nausea and increased flow of

salivary, biliary, and bronchial secretions. In persons sensitive to its influence vertigo and flushing may appear in addition.

With large doses these effects are increased in intensity; nausea appears at once and vomiting later occurs without producing excessive prostration, an excess of the drug being ejected before it has had time to induce marked depression.

These effects are due mainly to the alkaloids contained in ipecac, especially the cephaeline. They are the result not of direct stimulation of the vomiting center in the medulla, but of local irritation of the stomach, previous administration of bismuth or cerium oxalate preventing the vomiting. Subcutaneous injection of the ipecac principles induces vomiting only after a considerable delay and where the amount administered has been large, excretion of the drug into the stomach being required before emesis will result.

The smaller therapeutic doses of ipecac, in addition to nausea, give rise to customary accompaniments of this symptom, viz., increased perspiration, saliva; augmented flow of mucus, particularly in the respiratory tract; temporary acceleration of the pulse, and general weakness.

Circulation. — Both emetine and cephaeline tend to lower blood-pressure by depressing the heart, but this effect is much less marked upon hypodermic administration than upon intravenous. Both the active alkaloids of ipecac have been observed to constrict the blood-vessels after destruction of the brain and spinal cord, especially emetine. This vasoconstriction, however, is not effectual in preventing a diminution of blood-

pressure during the period of nausea from full therapeutic doses; and where toxic doses are given to animals, the direct cardiac depression is such as likewise to preclude any rise of blood-pressure. The pulmonary system seems to be depleted of its blood, judging from the pallor of the tissues *post mortem*, an active hyperemia of the gastrointestinal tract apparently acting as compensating factor.

Secretions. — Ipecac tends to increase secretions, especially those of the respiratory tract and skin, as already mentioned under ALIMENTARY TRACT, DISEASES OF.

UNTOWARD EFFECTS AND POISONING.—Excessive doses of ipecac produce, if vomiting fails to take place or does not sufficiently remove the drug, the effects of irritant drugs in general, viz., abdominal pain, diarrhea, and bloody stools, followed by collapse. Acute nephritis may occasionally result.

Urticaria sometimes follows the internal use of ipecac.

In the lower animals lethal doses of emetine cause death by paralysis of respiration, the heart continuing to functionate after respiratory movements have ceased. The surface temperature falls, but the internal temperature either remains stationary or exhibits a slight rise, owing to the irritant action of the emetine upon the intestinal mucous membrane (d'Ornellas).

Post-mortem examination of animals killed by emetine reveals considerable gastrointestinal irritation. The lungs are often hyperemic and present patches of hepatization; sometimes, however, they are exsanguinated.

Treatment of Poisoning.—Poisoning by ipecac or its alkaloid, emetine, is rare. The indications, where it occurs, are to remove the drug from the stomach, if possible, by means of the **stomach-tube**. **External heat**, together with the administration of **ammonia**, **strychnine**, and other respiratory stimulants, as well as **digitalis**, should be resorted to.

The toxicity of emetine has generally been overstated. The usual dosage of 0.5 to 1 grain (0.03 to 0.06 Gm.) of emetine per day for 6 or 8 days is certainly on the safe side unless the patient shows an unusual susceptibility to the drug. The real danger lies in the too long continued use of therapeutic doses, an entirely unnecessary procedure in the treatment of amebiasis, as the active endamebas will be destroyed by 0.5- or 1- grain (0.03 to 0.06 Gm.) doses in 6 to 12 days, and the encysted forms, if present, will not be destroyed by continued emetine injections. Walters and Koch (*Jour. Pharm. and Exper. Therap.*, July, 1917).

THERAPEUTICS.—Ipecac is a safe and efficient emetic. It is free from depressing and irritating effects when given in ordinary doses. On the other hand, it is sometimes slow in its action. Ipecac in emetic doses (4 to 20 grains—0.26 to 1.3 Gm.—of the powder or 1 to 6 fluidrams—4 to 24 c.c.—of the wine) may be used to empty the stomach in cases of **acute indigestion**, **migraine**, or bilious sick headache. In membranous croup, **bronchial asthma**, **capillary bronchitis**, lodgment of **foreign bodies**, **pertussis**, and in **laryngismus stridulus** it may be employed in emetic doses for its mechanical effects. In the bronchitis of small children, who swallow the mucus coughed up from the lungs instead of expectorating it, emetic

doses of ipecac will relieve the stomach and improve the condition of the lungs.

As an emetic in cases of poisoning ipecac is inferior to mustard or the sulphate of zinc or copper on account of its less efficient and slower action.

As an antemetic, in small doses— $\frac{1}{10}$ to $\frac{1}{4}$ grain (0.006 to 0.015 Gm.) of the powder every hour—ipecac holds a high place. It is useful in vomiting of drunkards, of **pregnancy**, of **migraine**, and especially in **nervous vomiting** and the morning vomiting which sometimes accompanies general weakness of **convalescents** from acute diseases. In the vomiting of children with **acute catarrhal gastritis** ipecac is also useful. It has a greater influence over the vomiting of children than over that of adults. The vomiting occurring with **cancer of the stomach** is sometimes relieved by ipecac after the more commonly used remedies have failed. Small doses— $\frac{1}{10}$ to $\frac{1}{6}$ grain (0.006 to 0.01 Gm.)—are beneficial where **hepatic torpor** and insufficient excretion of bile exist. In flatulent dyspepsia doses of $\frac{1}{10}$ to $\frac{1}{4}$ grain (0.006 to 0.015 Gm.) given after meals are followed by a subsidence of the **flatulence**. One grain (0.06 Gm.) of pulverized ipecac taken fasting every morning will remove **dyspepsia** associated with **constipation**, cold extremities, and a feeling of weight in the stomach.

In children 18 months to 4 or more years old suffering from constipation, anorexia, faulty gastric secretion, etc., with resultant intoxication, anemia, poor nutrition, and defective development, the best results are obtained by the administration of ipecacuanha in ascending doses. Careful regulation of the diet is also required. R. St. Philippe (*Gaz. méd. belge*, May 15, 1913).

An ointment of the powder of ipecac (25 per cent.) has been used as counterirritant. In the early stage of **bronchitis**, when the secretion from the lungs is abundant and tenacious, ipecac will do good service in non-emetic doses. Even the inhalation of wine of ipecac in the form of a spray produced by hand atomizer has been recommended in the treatment of **hoarseness**, winter cough, and **bronchial asthma**. For this purpose the wine may be used either pure or diluted with 1 or 2 parts of water. At the first application it sometimes excites a paroxysm of coughing, which generally soon subsides; but should it continue, a weaker solution should be used. As a rule, the patient at first will bear about 20 compressions of the bulb without nausea. The inhalation should be used at first daily, and in bad cases two to four times daily; later, every other day suffices, and the interval may be gradually extended. As the spray is used for its topical effect, the patient is directed to spit out, or even to rinse out, the mouth at each pause in the administration, for a much larger quantity of the wine collects in the mouth than passes into the lungs. In this way vomiting and even nausea are avoided.

In congestion of the lungs following **influenza** Huchard prescribed as follows:—

℞ *Powdered ipecac* gr. iij (0.2 Gm.).
Ergotin 3ss (2 Gm.).
Brandy f3x (40 c.c.).
Mucilage of acacia f3iiiss (100 c.c.).

M. Sig.: One tablespoonful every hour.

In the early stages of **bronchopneumonia** Grasset administers full doses of ipecac in the following form:—

℞ *Powdered ipecac* 3ij (8 Gm.).
Bitter orange-peel ... 3j (4 Gm.).
Water f3iv (120 c.c.).

Reduce to 3 fluidounces (90 c.c.) by boiling, and add:—

Syrup of orange flowers f3j (30 c.c.).

Sig.: One teaspoonful every three or four hours.

In **bronchitis**, especially in children, and in **laryngitis** or **tracheitis**, syrup of ipecac is of great value. The following may be ordered for a child 3 years of age, 1-dram (4 c.c.) doses being given every one and one-half to three hours:—

℞ *Ammonii chloridi* gr. xlv (3 Gm.).
Tinctura opii camphorata . gr. lxxv (5 Gm.).
Syrupi ipecacuanhae ꝑc (7 Gm.).
Syrupi tolutani. f3vj (25 Gm.).
Aquæ anisi,
q. s. ad f3iij (90 c.c.).

M.

To stimulate hepatic action the author gives the powdered extract of ipecac in capsules or pill form, never using the wine or tincture. S. Floersheim (Med. Standard, Dec., 1913).

In the treatment of **hemorrhage** it may be used alone or in combination with ergot or other antihemorrhagic agent. It is recommended that for this purpose ipecac be given in frequently repeated doses until vomiting ensues. It has been successfully used in **hemoptysis**, **epistaxis**, **menorrhagia**, etc. Subcutaneous injections of $\frac{2}{3}$ grain (0.04 Gm.) of emetine hydrochloride have been strongly recommended by Flandin, Joltrain, and others in hemoptysis. By the use of this alkaloid nausea and vomiting are avoided.

The wine of ipecac given in doses of 10 to 15 minims (0.6 to 1 c.c.) has been successfully used in **uterine in-**

ertia in the first and second stages of labor. For general use, however, other agents are superior.

Five cases of severe **hematemesis** and **melena**—in patients with **hepatic cirrhosis**, **ulcerative enterocolitis**, and **uremic ulcer of the stomach**—treated with subcutaneous injection of 1 grain (0.06 Gm.) of emetine hydrochloride after ordinary remedies had failed. Hemorrhage ceased and did not recur. By way of caution, injections of $\frac{1}{3}$ grain (0.02 Gm.) were given on the succeeding days. Another author found emetine ineffective in 2 cases of severe internal hemorrhage in typhoid fever, but observed cessation of an obstinate and abundant intestinal hemorrhage in a severe case of **jaundice** after 3 injections of $\frac{2}{3}$ grain (0.04 Gm.) of emetine hydrochloride, as well as in a case of recurrent **epistaxis**. L. Rénon, Lesné, and F. Ramond (Bull. et mém. de la Soc. méd. des Hôp. de Paris, Jan. 29, 1914).

Ipecac is used by the writer in diseases of the heart. In disorders of the auricle, which he believes are very often of toxic origin, ipecacuanha seems to be a valuable adjunct to digitalis. He prescribes $\frac{1}{2}$ grain (0.03 Gm.) of powdered digitalis, and $\frac{1}{8}$ grain (0.008 Gm.) of powdered ipecacuanha. Nausea is not hastened, and the effect of the digitalis seems to be improved. In a person with an untreated **fibrillation**, the pulse being very rapid and irregular, the writer orders powdered digipuratum, 18 grains (1.2 Gm.), and powdered ipecac, 5 grains (0.3 Gm.) made into 12 powders. One every 4 hours until 4 are taken; one every 6 hours until 4 are taken; and one every 8 hours until 4 are taken. Ipecacuanha has certain analogies to digitalis which suggest it as an adjuvant. L. F. Bishop (Med. Record, Aug. 31, 1918).

In **amebic dysentery** ipecac is so efficient as to be generally considered a specific. The most efficient mode of administering it appears to be to

give the alkaloid emetine in the form of the hydrochloride (*v.* **EMETINE**). Where the whole drug is used, it is best given in the dose of 40 grains (2.6 Gm.) in pills coated with phenyl salicylate and keratin, these coatings having for their purpose to prevent liberation of the drug until it reaches the intestine, nausea and emesis being thereby avoided. Where given without such a protective covering, the drug — often administered to the amount of 60 to 90 grains (4 to 6 Gm.) in severe cases—is expected to produce vomiting, after which small doses of 2 to 3 grains (0.13 to 0.2 Gm.) are given every hour, and continued until a profuse black stool occurs. This latter is a favorable prognostic sign, while its non-appearance is significant of danger. The great depression resulting from this mode of administration has to be counteracted by the free exhibition of stimulants. According to Wigglesworth, the preliminary use of $\frac{1}{2}$ -fluidounce (15 c.c.) doses of a saturated solution of magnesium sulphate and of 15-minim (1 c. c.) doses of dilute sulphuric acid every two hours, with a milk diet, completely prevents the nausea usually induced by ipecac. (See also **EMETINE**, Vol. IV.)

The author treats **amebic dysentery** and **liver abscess** by employing emetine in as large an initial dose as possible, pushing it as rapidly as possible to toleration, and keeping it there until satisfied that the infection has been eliminated. W. M. James (Amer. Jour. of Trop. Dis. and Prevent. Med., Dec., 1913).

Six cases of **amebic dysentery** treated with emetine. The total injected varied from 2.5 to 14 grains with an average of about 3 grains. Five patients were cured clinically, 2 were greatly improved, and none

died. One of the "cured" cases recurred five months later.

The average dose is $\frac{1}{2}$ grain dissolved in 10 to 15 minims of normal saline solution and injected subcutaneously in the outer or back part of the arm over the deltoid. This dose is administered daily for three to seven days, depending upon the return of the stools to the normal in number and appearance, the absence of amebas, and the healing of the ulcers as shown by the proctoscope. When the signs and symptoms indicate a clinical cure the emetine should be discontinued, for an excess will cause bowel irritation, as the author witnessed in 2 cases. The only reaction to hypodermic doses of $\frac{1}{4}$ to 1 grain is local induration and tenderness for about one week. Rogers and others have reported good results from giving keratin-coated pills of emetine by mouth. They caused severe emesis in 2 of the author's patients. During the treatment the patient should have a bland diet and rest as much as possible, though confinement to bed seems unnecessary.

Mucus, pus, and blood may continue to be evacuated for some time after all amebas have disappeared from the stools. Irrigations and topical applications through the proctoscope will materially hasten the process of tissue repair. F. C. Yeomans (N. Y. Med. Jour., Feb. 14, 1914).

Ipecac has been found very useful in the treatment of that form of **acute hepatitis** which in the tropics eventuates in hepatic abscess, and is due to the ameba of dysentery.

In the **diarrhea of cholera Asiatica** and **cholera morbus** ipecac, in the dose of 3 grains (0.2 Gm.), given every two hours, has been followed by good results.

The diaphoretic properties of ipecac are not infrequently utilized in the beginning of fevers, colds, and other inflammatory conditions, for which

purpose it is associated with opium, as in the official *pulvis ipecacuanhæ et opii*.

In **poison-ivy dermatitis** the free application of a wash consisting of 3 drams (12 Gm.) of powdered ipecac to a pint (500 c.c.) of water has been recommended by W. S. Gilmore. Neall recommends the use of 1 part of powdered ipecac in 8 parts each of alcohol and ether to relieve the inflammation caused by **mosquito bites**. Powdered ipecac made into a paste and smeared on the skin is said to relieve the pain and swelling produced by the **sting of bees**.

C. E. DE M. SAJOURS

AND

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IRIS, CILIARY BODY, AND CHOROID, DISORDERS OF.—

The iris, ciliary body, and choroid, constituting the "uveal tract,"—the vascular or nutritive coat of the eye,—are best considered together.

The inflammations and degenerations that commonly affect the uveal tract are especially dependent on constitutional conditions which are often obscure; but which must be carefully hunted out and treated. The proper regimen or general treatment is often more important than local measures.

ANOMALIES OF THE IRIS AND CHOROID.—Albinism.

—Absence of pigment in the uveal tract accompanies the lack of pigment in the hair and skin throughout the body. The iris has a dull, gray-blue color; the pupil by ordinary illumination may appear red. With the ophthalmoscope, red fundus-reflex may be seen through the iris, and the choroidal vessels are distinctly visible

against the yellowish-white background of the sclera. Such eyes usually present high errors of refraction, for which correcting lenses should be worn.

Aniridia is complete absence of the iris. By ordinary inspection it may seem uncertain what the condition of the interior of the eye really is. But with the ophthalmoscope the red of the fundus-reflex is obtained through every part of the cornea, interrupted by a smooth dark circle near the periphery of the reflex, the margin of the crystalline lens. It occurs either as a congenital anomaly, or after trauma causing extrusion of the iris or its folding back on the ciliary process.

Coloboma of the iris is an extension of the pupil usually downward. Generally the edge of the crystalline lens can be seen in the coloboma, and often it is slightly notched. The defect may extend back into the choroid, causing a white patch which may reach to the optic nerve. Such defects are often hereditary. Displacement of the pupil is called *corectopia*.

Coloboma of the choroid is a congenital lack of choroid in some part of the fundus. Sometimes it is merely a rounded area through which the sclera is seen; sometimes it extends from the equator of the eye back to or including the optic disk. It is to be distinguished from patches of choroidal atrophy or retinal exudation by its smooth, rounded margin. Partial coloboma may involve the superficial layers, leaving the larger vessels visible.

Persistent pupillary membrane, the remains of the fibrovascular membrane which closes the pupil during early fetal life, appears as one or more

threads that stretch across the pupil, or from the iris to an opaque area of the lens-capsule within the pupil. They are distinguished from posterior synechiæ by the fact that they arise not from the margin of the pupil, but from the front of the iris at some little distance from the pupillary margin.

Polycoria, multiple pupils, may be caused by division of the normal pupil into two by a band of persistent pupillary membrane, or it may be from openings in other parts of the iris. Only the central or true pupil is furnished with a sphincter muscle. Polycoria sometimes arises by atrophy of some parts of the iris, following injury and the formation of firm synechiæ in childhood.

IRITIS; CYCLITIS; IRIDOCYCLITIS.

Plastic inflammation of the iris and ciliary body includes iritis, cyclitis, iridocyclitis, parenchymatous and serous iritis, and the varieties of iritis named syphilitic, rheumatic, etc., according to the supposed cause.

Symptoms.—Pain in and about the eye, becoming severe, worse at night, and preventing sleep, is rarely absent. In poorly nourished women approaching middle life, what is called *quiet iritis* or *uveitis* occurs without pain and with little redness, so that the iris is firmly bound down to the lens capsule before the disease is noticed. Redness is seen in the pericorneal zone, and the color of the iris is altered and the pupil contracted by hyperemia. The iris is thickened and its surface dull. Vision is impaired by haziness of the media. Plastic exudate causes the iris to adhere to the anterior capsule of the lens, *posterior synechia*. When the ciliary body is

much involved, dots of exudate are deposited on the posterior surface of the cornea, usually on a triangular area at the lower part, *keratitis punctata*, and the ciliary region is tender to touch.

The synechiæ prevent the dilatation of the pupil under a mydriatic, the pupil therefore becoming irregular in shape. In a few cases the exudate into the iris and the formation of synechiæ occur while the pupil is partly dilated, and the usual contraction of the pupil is prevented.

ETIOLOGY.—Iritis may be caused by traumatism, but usually arises from some dyscrasia. Half of all cases are due to syphilis; other causes in the order of their frequency are rheumatism, anemia, acute febrile diseases, diabetes, gonorrhea, gout, and new growths in the iris. Autointoxication of gastrointestinal origin is an important cause of relapsing inflammations of the uveal tract. In syphilis iritis occurs in the secondary stage within a year after infection. With rheumatism it may occur with or between other manifestations of the disease. It arises during convalescence from acute fevers. Patients who have latent gonorrhea are liable to attacks for many years after infection.

Recent observations seem to show that uveal inflammations are due to direct bacterial invasion of the uveal tract.

DIAGNOSIS.—Iritis and cyclitis quite often coexist. Iritis may be considered absent if there is no visible alteration of the iris and the pupil dilates widely and evenly under a mydriatic. Cyclitis is absent if there are no deposits on the cornea, or haziness of the vitreous, or tenderness of the ciliary region. Iritis and cyclitis

must be distinguished from keratitis by absence of change in the cornea; from glaucoma by the contracted pupil, and the absence of dilated scleral veins, increased tension or cupping of the optic disk; from panophthalmitis by the absence of swelling of the lids and dense opacity of the vitreous; from neuralgia by the redness of the eye and the alteration of the iris; from conjunctivitis by the slight swelling and freedom from discharge of the conjunctiva. The alterations in the pupil are best seen with the ophthalmoscope or after the use of a mydriatic. In general the pupil is distorted and irregular in shape. But these irregularities may be slight and difficult to make out when the pupil is small and adherent to the lens capsule all round its margin.

PROGNOSIS AND SEQUELÆ.

—Iritis is a slow, painful disease, dangerous to the future usefulness of the eye. Eyes that do well may take many weeks to recover, and pain may continue or increase many days after efficient treatment is begun. It is liable to relapse or recur, especially in rheumatic or cachectic patients. When the whole margin of the pupil is bound down to the lens, *exclusion of the pupil*, the forward current of fluid from the posterior chamber is obstructed, pushes forward the iris, and causes secondary glaucoma. Extensive plastic deposits about the lens and in the vitreous are followed by softening and shrinking of the eyeball with detachment of the retina, blindness, and degenerative changes in all parts of the eye. Few cases of iritis recover absolutely, although many eyes remain quiet and useful throughout life. The greatest danger

is from recurring attacks, if the general condition causing the uveal inflammation be not recognized and overcome.

Sometimes iritis causes a myopia that may last for some months.

TREATMENT.—The eye should be promptly put under the influence of a mydriatic, preferably **atropine**, which should be continued until the eye is free from redness, except in a few cases of cyclitis without iritis, which do better with the pupil undilated. The prevention and breaking up of synechia by such a drug is usually of greatest importance. The eyes should be given complete rest, and protected from sudden changes of light. **Dark glasses** may be worn in the sunlight. The general nutrition of the patient is so important that confinement to a dark room should not be continued more than a few days. Pain may be relieved by **bathing the eye with very hot water** from three to five minutes several times a day; or by taking blood from the temple. Sometimes **dionin** gives much relief. It should be used once or twice a day, either in powder or a 5 per cent. solution.

The treatment of the general or constitutional condition underlying the attack of iritis is of equal or greater importance than the local treatment, and is much more frequently neglected.

Internally **calomel** should be given, irrespective of the cause of the iritis, until the bowels have freely moved, and **mercury** continued by **inunction** or in other forms in the syphilitic cases. Whatever constitutional condition is present is to be carefully treated, and tonics used to build up the general condition.

The influence of **salvarsan** is strik-

ingly favorable, sometimes producing in a few days a cure that would have required as many weeks or even months under older methods. It should, however, be followed by a prolonged course of **mercury**. In iritis arising from autointoxication **calomel** may be continued, in doses sufficient to keep the bowels loose, for several weeks, care being taken to avoid other manifestations of mercurial poisoning. **Diet** should be carefully regulated. **Hot** or **Turkish baths** repeated at intervals of one, two, or more days, according to the acuteness of the symptoms and the strength of the patient, are very useful. Large doses of **sodium salicylate** may be given for a few days in acute cases. **Pilocarpine** sweats may be useful in more chronic conditions.

Iridectomy.—The excision of a part of the iris may be required for the sequels of iritis, as exclusion of the pupil or extensive synechia; for *occlusion* of the pupil, its closure by a deposit of lymph; for corneal opacity in front of the pupil, some part of the cornea remaining clear; for partial opacity of the lens; or for glaucoma.

Location.—If done to secure a clear passage for light through the dioptric media—*optical iridectomy*—it must be located so light can enter through the best dioptric surfaces, must be as small as will remain subsequently unobstructed, and must be exposed when the lids are opened. If it is merely to free the iris from its adhesions, or open up a passage from the posterior to the anterior chamber, or for glaucoma, it should be placed where it will ordinarily be hidden as much as possible beneath the lids. For glaucoma it should be large, including one-fifth of the circumference of the iris,

and should extend up to the ciliary margin.

Technique.—An incision is made in the cornea between the location for the iridectomy and the corneal margin, slightly longer than the width of the iridectomy and parallel to the corneal margin. This is made either with a narrow Graefe knife or a lance-shaped keratome. A pair of iris-forceps is introduced and the iris seized near its pupillary margin, and the part so caught is drawn outside the corneal incision. Sometimes the iris can be better separated from adhesions by a blunt iris-hook which is pressed upon the pupillary edge of the iris until it catches under it, and draws it out through the corneal incision. A sufficient portion of the iris having been drawn out, it is cut off with fine scissors, the stump is returned within the eye, care being taken to free it entirely from the corneal incision; and the eye is closed with a light dressing until the corneal wound ceases to allow the escape of the aqueous. Usually but a few hours are required for this.

Iridectomy should not be done for the sequelæ of iritis until long after the eye has become free from redness or irritability.

CHOROIDITIS.

Plastic inflammation and atrophy of the choroid is more of a chronic degenerative process than an acute inflammation. It often accompanies similar inflammation of the iris and ciliary body, and is variously designated *choroiditis*, *iridochoroiditis*, and *choroidal atrophy*.

VARIETIES.—When one or two large areas of the choroid are affected at once it is called *diffuse choroiditis*. When small areas are affected, the

remainder of the choroid being normal, it is called *localized choroiditis* if only one or two patches appear, or *disseminated choroiditis* if there are several. When the region of the macula is involved it is called *central choroiditis*, and a form of the central occurring in old persons is called *senile*. The process may affect only the superficial layer of the choroid, or it may involve the deeper layer.

SYMPTOMS.—Only the appearances revealed by the ophthalmoscope are characteristic of this disease, although it may be attended with discomfort or aching in and about the eyes, flashes of light, impairment of vision by scotomata, or clouds due to vitreous opacities. In the early stages of exudation the choroid may be swelled; it is lighter and yellower than normal, and may be veiled by haziness of the vitreous, but there are no pigment deposits. Later, as the process passes on to atrophy, the margins and parts included in the affected area show brown or black pigment deposits, between which may be seen the large vessels of the deep layer of the choroid or the white sclera. Throughout the disease the retinal vessels run over the affected area undisturbed. When the atrophy and pigment deposits are complete, the appearances produced tend to continue throughout life.

ETIOLOGY.—The causes of inflammation of the iris and ciliary body similarly affect the choroid. Especially is it liable to present lesions due to syphilis or tuberculosis. In addition, it is liable to suffer from eye-strain in hyperopia, astigmatism, and most extensively in myopia. Excessive use of the eyes and exposure to excessive light and heat, especially

when habitually concentrated on one part of the choroid, are also important causes.

DIAGNOSIS.—Choroiditis is recognized with the ophthalmoscope by the color and pigmentation of the affected areas. It has to be distinguished from exudation or opaque nerve-fibers in the retina which hide all detail of the pigment layer and some parts of the retinal vessels, and from coloboma of the choroid, which has a smooth margin where parts of the largest choroidal vessels may be seen against a white background.

PROGNOSIS.—Choroidal inflammation is always serious. Its obscure, persistent causes, difficult of recognition and removal, make it generally a disease likely to continue until it has done very grave damage to the eye. It is worth every effort to permanently check its progress. Cases where it is localized and does not involve the macula are the most favorable, and may end in cure without noticeable impairment of vision.

TREATMENT.—Complete rest for the eyes, often under a mydriatic, is important, with protection from sudden changes or great excess of light, or exposure to heat. This will sometimes require a change of occupation, as the giving up of cooking or blacksmithing. **Correcting lenses** must be constantly worn, and during the acute stage much use of near vision should be avoided. The underlying dyscrasia must also receive efficient treatment, for upon this will depend the persistence and extension of the disease and the ultimate results. Syphilis should be combated by the prolonged use of **mercury**; with, sometimes, **iodides** late in the disease. A general tonic regimen is generally

required. **Outdoor life** is beneficial, and on account of its depressing influence upon general nutrition, prolonged confinement to a dark room should be carefully avoided.

UVEAL TUBERCULOSIS is of more frequent occurrence than was formerly supposed. It is usually secondary to a tuberculous focus situated elsewhere in the body. When chronic, its prognosis is comparatively good under efficient treatment for the general disease, especially under the use of **tuberculin**.

The **iris** is commonly involved in children. Small, isolated, gray nodules appear scattered throughout that membrane; these are attended with the ordinary symptoms of iritis. If the cause be not recognized and effectively treated, the iris becomes bound down by posterior synechiæ, and vision reduced to light perception by lesions of the deeper parts of the eye, before the disease becomes quiescent.

Tuberculosis of the choroid may be either acute or chronic. The **acute** condition arises in acute general tuberculosis of children and young persons, during the last few days or weeks of life. The choroidal involvement is quite common, but is only revealed by the ophthalmoscopic examination and will escape notice unless carefully looked for. The tubercles are seen as oval or rounded yellowish spots, devoid of pigmentation, and one-half the size of the optic disk or less.

Chronic tuberculosis of the choroid may take either of two distinct forms. A large mass or tumor may develop, presenting most of the symptoms of other choroidal tumors. This form is rare, but its nature has long

been recognized. In the other form the tubercles are small, occur singly or one or two at a time successively, run their course in a few weeks or months, and leave a patch of choroidal atrophy with marked pigment deposits. Such lesions occur in young or even older adults. They are not very rare, but only recently has it been recognized that they are of tuberculous origin.

DIAGNOSIS.—The appearance of the lesions, though suggestive, is not characteristic. The iris nodules are seen in children, while those of syphilis appear later in life. The patches of choroidal tubercle have quite indefinite borders, and are at first free from pigment. Later the pigment appears in the midst of the patch rather than about its margin.

But the diagnosis must rest chiefly on the various tests with tuberculin. These are of great value. Only after skin tests and tuberculin injections have repeatedly failed to give local or general reactions, can this cause be excluded. The focal reaction may be noticeable on close examination of the uveal lesion in a minority of cases. It is the most convincing proof of the nature of the process.

PROGNOSIS.—This has been completely changed by the recognition of the nature of these lesions and the development of tuberculin therapy. Without such treatment the eye was greatly damaged or lost. With it the great majority of eyes improve and continue useful; and in some cases recovery is practically complete.

TREATMENT.—This includes the general regimen for tuberculosis, with special care not to use the eyes for close work, and **atropine** for acute inflammatory manifestations. A series

of **tuberculin** injections should be given, beginning with very small doses given about once a week, and continued over many months, or one or more years. Until the general liability to tuberculous lesions is overcome the eye will not be safe from recurrences.

PURULENT INFLAMMATION OF THE IRIS, CILIARY BODY, AND CHOROID.—Although in grave plastic iritis hypopyon may appear, the exudate becoming largely purulent, these cases running the general course of plastic iritis require no separate consideration. A totally distinct clinical picture is presented when general suppuration of the uveal tract occurs. The condition is then called *suppurative choroiditis*, or *iridochoroiditis*, or from its involvement of all parts of the eye, *panophthalmitis*.

SYMPTOMS.—The disease begins with great disturbance of vision, pain in and about the eye, and general redness. The conjunctiva, the lids, and often the tissues of the orbit become greatly swelled. Haziness of the vitreous quickly prevents any view of the fundus, and the eye rapidly becomes entirely blind. The pain continues to increase until the sclero-corneal coat is perforated, allowing exit to the contained pus. Then pain rapidly diminishes, the swelling goes down, and the eyeball soon shrinks to a small, sightless, and generally harmless stump: *phthisis bulbi*.

ETIOLOGY.—Suppuration of the uveal tract arises from infected wounds, either accidental or operative; from perforating ulcer or abscess of the cornea; or thrombosis of the orbital veins in orbital cellulitis. It may also be produced by metastasis or em-

bolism in connection with abscess in other parts of the body; in pyemic conditions, puerperal sepsis, or erysipelas, or in cerebrospinal meningitis, influenza, scarlatina, and other acute specific fevers.

DIAGNOSIS.—The disease cannot escape notice unless masked by previous inflammation of the orbit, erysipelas of the lids, or suppuration of the cornea; or unless it occur in the course of exhausting disease, when the local reaction may be slight, and the loss of vision unnoticed by the dull or unconscious patient. It is to be distinguished from other ocular inflammations by the opacity of the vitreous and rapid loss of sight, or when it supervenes upon corneal ulcer, by increase of pain and swelling.

PROGNOSIS.—Most cases run a rapid course to complete blindness and phthisis bulbi. In a few the reaction is less severe and a purulent accumulation in the vitreous simulating in appearance glioma of the retina remains indefinitely. Such cases are called *pseudoglioma*. In a very few cases in children, where the purulent chorioiditis follows specific fevers, and especially cerebrospinal meningitis, some sight is retained, and the vitreous humor may subsequently clear up to a considerable extent.

TREATMENT.—Pain is most promptly relieved and the disease cut short by **enucleation of the eye**; but this has in a few cases been followed by death from meningitis. Some authors believe that the risk of meningitis is increased by enucleation; but this is very doubtful if proper care is taken to cleanse the wound and secure free drainage.

When, because of the patient's condition or disinclination, enucleation

cannot be done, the eye should be **poulticed**, and after two or three days opened by a free **incision across the cornea** that will permit the escape of the crystalline lens and all purulent accumulations. Analgesics, such as **morphine** and **acetanilid**, may be necessary until the eye is opened. If the eye retains some sight, poulticing is improper; **rest, atropine, and bleeding** from the temple are indicated. Even where the eye is blind, but the pain and swelling not severe, as in pseudoglioma, it may be wise to defer operation until the general health is improved.

TUMORS OF THE UVEAL TRACT.—This is a not very unusual seat of secondary tumors, although they may attract little attention, appearing late and growing slowly. The following are the principal primary new growths:—

Cyst of the iris is apt to follow a penetrating wound in which a bit of epithelium or eyelash has been implanted on the iris. It may have the form of a serous cyst occupying a large part of the anterior chamber, or an epithelial pearl on the surface of the iris. Either form may cause secondary glaucoma. It should be **excised**.

Gumma may develop in the iris, causing one or more rounded swellings, attended with iritis; or in the ciliary body, where it is also attended with inflammation, and may cause ciliary staphyloma either from its primary swelling or by thinning of the overlying sclera by absorption so that it cannot resist intraocular pressure. In the iris it usually leaves a thinned and atrophied spot through which may in some cases be seen the fundus-reflex. Active antisyphilitic

treatment is indicated. **Salvarsan** causes rapid improvement.

Ossification of the choroid is often found in eyeballs that have long been blind, and have undergone extensive degenerative changes. It may cause sympathetic irritation, but not inflammation, of the fellow-eye.

Sarcoma may arise primarily in either part of the uveal tract. In the iris it appears as a tumor which grows very slowly, usually brown and deeply pigmented, sometimes of lighter color, with visible vessels.

Sarcoma of the ciliary body may first manifest itself in the pupil or by pushing forward the iris; or it becomes adherent to the iris and by its growth drags the iris away from its ciliary attachment, revealing the tumor beneath.

Sarcoma of the choroid starts as a rounded displacement of the retina, which is not wavy like an ordinary detachment, and through which large vessels may be seen.

For many months or years uveal sarcoma grows slowly, giving rise to no other symptoms; this is its first, or latent, stage. Then it causes increased tension of the eyeball and inflammation: the second, or inflammatory, stage. The third stage begins when it perforates the sclera and begins to invade neighboring tissues. It now grows rapidly. The fourth stage begins with the extension of the disease by metastasis to other organs.

Diagnosis.—In the early stage the ophthalmoscopic examination revealing the tumor, and its repetition at sufficient intervals showing increase in the size, gives definite and reliable information. After the retina becomes detached it is very difficult to determine if the detachment be pri-

mary or due to the tumor. In this stage transillumination of the eyeball through the sclera may be of great importance. When the retinal detachment is accompanied with increased tension of the eyeball the presence of a tumor is very probable. Exploratory or partial operations are to be avoided, owing to the danger of favoring extension or metastasis.

Treatment.—The earliest possible removal of the tumor is indicated. In a few cases of sarcoma of the iris this may be accomplished by **iridectomy**, removing the growth with the iris from which it springs. In all other cases the eye must be **enucleated**, and if perforation of the sclera has occurred the orbit should be emptied of its contents.

Carcinoma of the choroid is always secondary and occurs at an advanced stage of the primary disease. Nevertheless in a few cases the examination of an eyeball enucleated for tumor has occasionally led to the diagnosis of cancer, and the first recognition of the presence of the primary growth in some other organ. If the carcinomatous nature of the tumor is known, its **removal** is only justified to give relief from pain, since lesions elsewhere will prove fatal before the tumor in the eye causes other complications.

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IRON.—Iron (*ferrum*) is a metallic element occurring widely in nature, both in the animal and vegetable kingdoms and in inorganic compounds, chiefly iron oxide, carbonate, sulphide, and silicate. From its ores iron is extracted by first roasting in air, then reducing the resulting oxide with carbon.

As described in the U. S. Pharmacopœia, iron occurs in the form of fine, bright, non-elastic wire. The preparation of pure iron universally used, however, is "reduced iron," made by heating ferric oxide, Fe_2O_3 , in a stream of hydrogen gas, the latter taking up the oxygen of the oxide to form water and leaving a fine, blackish, odorless, and tasteless powder, insoluble in water and alcohol, but dissolving in mineral acids with the formation of salts.

Iron compounds are also known as chalybeates, or martial preparations (Mars: god of war). Mineral springs containing iron supply the so-called chalybeate waters. Two series of iron compounds exist—the ferrous, usually greenish in color, and containing a relatively large proportion of the metal, and the ferric, generally of a reddish-brown or, in dilute solutions, yellow color.

PREPARATIONS AND DOSES.

—The official iron preparations may be conveniently classified in three groups: First, the bland, or those devoid of energetic local effects, which may be subdivided into three classes, the insoluble and soluble solids and the liquids; second, the astringent or styptic; and third, the compound, in which there enters another active medicinal agent in addition to the iron:—

I. Bland Preparations.

(a) Solids Insoluble in Water.

Ferrum reductum (reductum, B. P.; reduced iron), required to contain not less than 90 per cent. of pure iron. Dose, 1 grain (0.06 Gm.).

Ferri carbonas saccharatus (saccharated ferrous carbonate), containing not less than 15 per cent. of ferrous carbonate [FeCO_3]. It is made by dissolving 5 parts of ferrous sulphate in hot distilled water, $3\frac{1}{2}$ parts of sodium bicarbonate in warm distilled water,

filtering the two solutions, adding the former to the latter, washing the resulting precipitate repeatedly with hot distilled water, mixing it intimately with 8 parts of sugar, evaporating to dryness on a water bath, reducing it to a powder, and mixing with it, if necessary, enough dried sugar to make 10 parts. The product is a greenish-brown powder, odorless, sweetish and then ferruginous in taste, only in part soluble in water, but dissolving completely upon the addition of hydrochloric acid, forming a yellowish liquid. Dose, 4 grains (0.25 Gm.).

Pilule ferri carbonatis (pills of ferrous carbonate; Bland's pills), made by rubbing up 8 parts of potassium carbonate with a little glycerin and water, adding 16 parts of granulated ferrous sulphate and 4 parts of sugar, previously triturated, and rubbing the mass thoroughly into it, assumes a greenish color. One part each of tragacanth and althea are then incorporated and, if necessary, a little more water added, to produce a mass of pilular consistence. If these pills are to be kept they must be coated, as they undergo change after a short time, becoming oxidized and turning red. Dose, 2 to 5 pills.

Best effects obtained from iron carbonate by giving it immediately after mixing, and having the ferrous sulphate and potassium carbonate in separate bottles. So prepared and taken, the precipitated carbonate is not long enough exposed to the air to produce the sesquioxide. The water used in making the two mixtures should be boiled in order to expel the air. R. E. Van Gieson (N. Y. Med. Jour., April 11, 1908).

Massa ferri carbonatis (mass of ferrous carbonate; Vallet's mass), made by dissolving 100 parts of ferrous sul-

phate and 46 parts of monohydrated sodium carbonate separately in boiling distilled water, adding syrup to the iron solution, filtering and cooling both, gradually introducing the iron solution into the carbonate solution, washing the resulting precipitate with syrup and distilled water, expressing the water from it, mixing it with 38 parts of clarified honey and 25 parts of sugar, and evaporating the product on a water bath, with constant stirring, until it is reduced to 100 parts by weight. Dose, 4 grains (0.25 Gm.).

Magma ferri hydroxidi, N. F. (ferric hydroxide), $[\text{Fe}(\text{OH})_3]$, a brownish-red, insoluble magma, made by adding diluted ammonia water to a solution of ferric sulphate and collecting and washing the precipitate. Used in the preparation of the arsenic antidote (see *Ferri hydroxidum cum magnesii oxido*).

Ferri hypophosphis, N. F. (ferric hypophosphite), $[\text{Fe}(\text{H}_2\text{PO}_2)_3]$, a grayish powder, odorless and almost tasteless, practically insoluble in water, more readily soluble in the presence of dilute hypophosphorous acid or in a warm, concentrated solution of the citrate of an alkali metal,—with which it forms a green solution,—and freely soluble in hydrochloric acid. Dose, 3 grains (0.2 Gm.).

(b) *Solids Soluble in Water.*

Ferri citras, U. S. P. VIII (ferric citrate), $[\text{Fe}_2(\text{C}_6\text{H}_5\text{O}_7)_2 + 6\text{H}_2\text{O}]$, pure enough to contain at least 16 per cent. of metallic iron, and occurring in thin, reddish-brown scales, slightly ferruginous in taste, slowly but completely soluble in cold water, and insoluble in alcohol. Dose, 4 grains (0.25 Gm.).

Ferri phosphas (the soluble ferric phosphate; iron phosphate with sodium citrate), $[\text{Fe}_2(\text{PO}_4)_2 + \text{Na}_3-$

$\text{C}_6\text{H}_5\text{O}_7]$, containing at least 12 per cent. of metallic iron, and occurring in bright-green scales, with an acidulous, slightly saline taste, freely soluble in water, and insoluble in alcohol. It becomes discolored upon exposure to light. Dose, 4 grains (0.25 Gm.).

Ferri pyrophosphas, N. F. (the soluble ferric pyrophosphate; iron pyrophosphate with sodium citrate), $[\text{Fe}_4(\text{P}_2\text{O}_7)_3 + \text{Na}_3\text{C}_6\text{H}_5\text{O}_7]$, containing not less than 10 per cent. of metallic iron, and occurring in apple-green scales, with an acidulous, slightly saline taste, and freely soluble in water. Dose, 4 grains (0.25 Gm.).

Ferri et ammonii citras (iron and ammonium citrate), $[(\text{NH}_4)_3\text{Fe}(\text{C}_6\text{H}_5\text{O}_7)_2]$, containing not less than 16 per cent. of iron, and occurring in garnet-red scales having a saline, slightly ferruginous taste, deliquescent in moist air, and freely soluble in water. Dose, 4 grains (0.25 Gm.).

Ferri et ammonii tartras, U. S. P. VIII (iron and ammonium tartrate), $[(\text{NH}_4)_3\text{Fe}(\text{C}_4\text{H}_4\text{O}_6)_3]$, not less than 13 per cent. of iron, and occurring in garnet-red to reddish-brown scales, having a sweetish, slightly ferruginous taste, and very soluble in water. Dose, 4 grains (0.25 Gm.).

Ferri et potassii tartras, U. S. P. VIII (iron and potassium tartrate; tartrated iron), $[\text{Fe}_2\text{O}_3 \cdot \text{K}_2(\text{C}_4\text{H}_4\text{O}_6)_2]$, not less than 15 per cent. of iron, and occurring in garnet-red to reddish-brown scales, having a sweetish, ferruginous taste, and freely soluble in water. Dose, 4 grains (0.25 Gm.).

(c) *Fluid Preparations.*

Liquor ferri et ammonii acetatis (solution of iron and ammonium acetate; Basham's mixture), made by adding to 50 parts of the official solution of ammonium acetate, 6 parts of

dilute acetic acid, 4 parts of tincture of ferric chloride, 12 parts each of aromatic elixir and of glycerin, and finally enough water to make 100 parts. Dose, 4 fluidrams (16 c.c.).

Basham's mixture is acidified by the use of dilute acetic acid to prevent the precipitation of any ferric hydroxide (brown color sometimes noticed in a poorly made preparation) from a poorly prepared solution of ammonium acetate. It must not be dispensed with alkalis. Foreman and Gertler (Jour. Ind. State Med. Assoc., Oct., 1909).

Mistura ferri composita, N. F. (compound iron mixture; Griffith's mixture), made by rubbing up 18 parts each of myrrh and sugar and 8 parts of potassium carbonate with 700 parts of rose water, adding 60 parts by volume of spirit of lavender and 6 parts of ferrous sulphate, the latter previously dissolved in rose water, and finally adding enough rose water to make 1000 parts by volume and mixing thoroughly. Dose, 4 fluidrams (16 c.c.).

Vinum ferri, N. F. (wine of iron), made by dissolving 4 parts by weight of iron and ammonium citrate in 70 parts by volume of white wine, adding 6 parts of tincture of sweet orange-peel and 10 parts of syrup, and finally adding enough white wine to make 100 parts; the mixture is to be set aside two days, then filtered. Dose, 2 fluidrams (8 c.c.).

II. Astringent Preparations.

(a) Solids.

Ferri chloridum (ferric chloride; iron perchloride, sesquichloride, trichloride), $[\text{FeCl}_3 + 6\text{H}_2\text{O}]$, containing not less than 22 per cent. of metallic iron in the form of chloride, and occurring in orange-yellow, crystalline pieces, with a strongly astringent taste and perhaps a faint odor of hydrochloric acid. It deliquesces in moist air, is

freely soluble in water and in alcohol, and melts to a reddish-brown liquid at $96^\circ \text{ F. (} 35.5^\circ \text{ C.)}$. Dose, 1 grain (0.06 Gm.).

Ferri sulphas (ferrous sulphate; copperas), $[\text{Fe SO}_4 + 7\text{H}_2\text{O}]$, occurring as large bluish-green crystals with a saline, astringent taste, freely soluble in water, but insoluble in alcohol. The crystals effloresce in dry air, become coated through oxidation with a brownish layer of basic ferric sulphate when exposed to moist air, and lose 6 molecules of the water of crystallization when heated to $239^\circ \text{ F. (} 115^\circ \text{ C.)}$. Dose, 3 grains (0.2 Gm.).

Ferri sulphas exsiccatus (exsiccated or dried ferrous sulphate), [approximately $2\text{FeSO}_4 + 3\text{H}_2\text{O}$], made by heating the preceding on a water-bath, constantly stirring, until the product is reduced to between 64 and 65 per cent. of its initial weight, and powdering the residue. The latter is grayish white and dissolves slowly but completely in water. Dose, 2 grains (0.125 Gm.).

Ferri sulphas granulatus (granulated ferrous sulphate; precipitated ferrous sulphate) $[\text{FeSO}_4 + 7\text{H}_2\text{O}]$, made by dissolving ferrous sulphate in boiling distilled water, adding dilute sulphuric acid and filtering while hot, concentrating the solution by evaporation, and precipitating it by the addition of alcohol. The product is a pale, bluish-green, crystalline powder, soluble in alcohol. Dose, 3 grains (0.2 Gm.).

Ferri et ammonii sulphas, U. S. P. VIII (ferric ammonium sulphate; ammonioferric alum), $[\text{FeNH}_4(\text{SO}_4)_2 + 12\text{H}_2\text{O}]$, not less than 11.5 per cent. of metallic iron, and occurring in violet, efflorescent crystals with an acid and astringent taste, soluble in 3 parts of water, but insoluble in alcohol. Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

(b) Liquids.

Liquor ferri chloridi (solution of ferric chloride), containing not less than 29 per cent. of the salt or 10 per cent. of iron, and made by heating iron wire with hydrochloric acid, filtering, adding more hydrochloric acid, mixing with nitric acid, warming again, removing the nitric acid, and adding hydrochloric acid and water to make a specified volume of solution. The product is a reddish-brown liquid, with an acid, strongly astringent taste and acid reaction. Dose, $1\frac{1}{2}$ minims (0.1 c.c.).

Liquor ferri subsulphatis (solution of ferric subsulphate, iron persulphate, or basic iron sulphate [approximately $\text{Fe}_4\text{O}(\text{SO}_4)_5$]; Monsel's solution), a preparation of variable chemical composition, containing an amount of the basic sulphate corresponding to not less than 13.57 per cent. of metallic iron. It is made by treating ferrous sulphate with hot sulphuric and nitric acids, destroying the nitric acid, and diluting to the proper concentration, and occurs as a reddish-brown liquid, strongly styptic and acid, miscible with water and alcohol in all ratios without decomposition. Dose, 3 minims (0.2 c.c.); used chiefly locally.

Liquor ferri tersulphatis (solution of ferric sulphate or iron tersulphate or sesquisulphate [$\text{Fe}_2(\text{SO}_4)_3$], containing about 36 per cent. of the sulphate). It is made in much the same manner as the preceding, but with different proportions of the ingredients. Used in the preparation of ferric hydroxide, and of ferric hydroxide with magnesium oxide (arsenic antidote).

III. Compound Preparations.*(a) Solids.*

Ferri et quiniæ citras, U. S. P. VIII (iron and quinine citrate), containing 11.5 per cent. of quinine and 13.5 per

cent. of metallic iron, and occurring in reddish-brown scales with a bitter, slightly ferruginous taste, slowly deliquescent, slowly soluble in cold water, more readily soluble in hot water, and partly soluble in alcohol. Dose, 4 grains (0.25 Gm.).

Ferri et quiniæ citras (the soluble iron and quinine citrate), containing the same percentages of quinine and iron as the preceding, and occurring in greenish, golden-yellow, bitter and deliquescent scales, rapidly soluble in cold water, and partly soluble in alcohol. Dose, 4 grains (0.25 Gm.).

Ferri et strychninæ citras, U. S. P. VIII (iron and strychnine citrate), not less than 0.9 nor more than 1 per cent. of strychnine and 16 per cent. of iron, and occurring in garnet-red to yellowish-brown scales, with a bitter, mildly ferruginous taste, deliquescent when exposed to moist air, soluble in water and partly soluble in alcohol. Dose, 2 grains (0.125 Gm.).

Pilulæ aloes et ferri, N. F. (pills of aloes and iron), made by mixing 7 Gm. (108 grains) each of purified aloes, dried ferrous sulphate, and aromatic powder, incorporating enough confection of rose to make a mass, and dividing into 100 pills. Dose, 2 pills.

Pilulæ ferri iodidi (pills of ferrous iodide [FeI_2]), each containing enough of the iodide to yield $\frac{2}{3}$ grain (0.04 Gm.) of metallic iron and $\frac{5}{6}$ grain (0.05 Gm.) of iodine, together with licorice, balsam of Tolu, sugar, etc. Dose, 2 pills.

(b) Liquids.

Ferri hydroxidum cum magnesiæ oxido (ferric hydroxide with magnesium oxide; arsenic antidote), made by mixing 10 fluidrams (40 c.c.) of the official solution of ferric sulphate (*liquor ferri tersulphatis*) with 4 fluid-

ounces (125 c.c.) of water, rubbing 150 grains (10 Gm.) of magnesium oxide with cold water to a smooth mixture, transferring the latter to a 1-quart (liter) bottle, filling it three-fourths full with water, and shaking. Just before use, the magnesia mixture is added gradually to the iron solution in another bottle, and the whole shaken. Dose, 4 fluidounces (120 c.c.).

Elixir ferri, quinine et strychnine phosphatum, U. S. P. VIII (iron, quinine and strychnine phosphates), each fluidram (4 c.c.) of which contains about 1 grain (0.06 Gm.) of ferric phosphate, $\frac{1}{2}$ grain (0.03 Gm.) of quinine and $\frac{1}{60}$ grain (0.001 Gm.) of strychnine. Dose, 1 fluidram (4 c.c.).

Glyceritum ferri, quinine et strychnine phosphatum, U. S. P. VIII (glycerite phosphates of iron, quinine and strychnine), each 15 minims (1 c.c.) of which contains about $1\frac{1}{4}$ grains (0.08 Gm.) of soluble ferric phosphate, 2 grains (0.12 Gm.) of quinine phosphate, and $\frac{1}{80}$ grain (0.0008 Gm.) of strychnine. Dose, 15 minims (1 c.c.).

Syrupus ferri, quinine et strychnine phosphatum, N. F. (syrup of phosphates of iron, quinine and strychnine), made by mixing 1 part of the preceding preparation with 3 parts of syrup. Dose, 1 fluidram (4 c.c.).

Syrupus ferri iodidi (syrup of ferrous iodide), containing about 5 per cent. of ferrous iodide, and occurring as a pale-green liquid with a sweet, strongly ferruginous taste and giving a neutral reaction. Dose, 15 minims (1 c.c.).

Vinum ferri amarum, N. F. (bitter wine of iron), made by dissolving 5 parts of soluble iron and quinine citrate in 50 parts of white wine, adding 6 parts of tincture of sweet orange-peel and 30 parts of syrup, and finally

adding enough white wine to make 100 parts. Dose, 2 fluidrams (8 c.c.).

Among the other preparations containing iron recognized in the National Formulary, the following may be mentioned:—

Elixir ferri hypophosphitis (N. F.). Dose, 1 fluidram (4 c.c.).

Elixir ferri lactatis (N. F.). Dose, 1 fluidram (4 c.c.).

Elixir ferri phosphatis (N. F.). Dose, 1 fluidram (4 c.c.).

Elixir gentiane et ferri phosphatis (N. F.). Dose, 1 fluidram (4 c.c.).

Elixir malti et ferri (N. F.). Dose, 4 fluidrams (16 c.c.).

Elixir pepsini et ferri (N. F. III). Dose, 2 fluidrams (8 c.c.).

Extractum ferri pomatum (N. F.), (ferrated extract of apples; crude malate of iron). Dose, 10 grains (0.6 Gm.).

Liquor ferri albuminati (N. F.). Dose, 2 fluidrams (8 c.c.).

Liquor ferri peptonati (N. F.). Dose, 2 fluidrams (8 c.c.).

Liquor ferri peptonati et mangani (N. F.). Dose, 2 fluidrams (8 c.c.).

Liquor ferri protochloridi (N. F.), (solution of ferrous chloride [FeCl_2], 30 per cent.). Dose, 10 minims (0.6 c.c.).

Liquor zinci et ferri compositus (N. F.). Used locally and externally as antiseptic, astringent and deodorant.

Pulvis ferri et quinine citratis effervescens (N. F. III). Dose, 90 grains (6 Gm.).

Pulvis ferri phosphatis effervescens (N. F. III). Dose, 90 grains (6 Gm.).

Syrupus calcii lactophosphatis et ferri (N. F.). Dose, 1 fluidram (4 c.c.).

Syrupus ferri citro-iodidi (N. F. III), (tasteless syrup of iodide of iron). Dose, 30 minims (2 c.c.).

Syrupus ferri lactophosphatis (N. F.). Dose, 1 fluidram (4 c.c.).

Syrupus ferri saccharati solubilis (N. F.). Dose, 75 minims (5 c.c.).

Syrupus ferri et mangani iodidi (N. F.). Dose, 15 minims (1 c.c.).

Tinctura ferri chloridi ætherea (N. F.), (Bestucheffe's tincture; Lamotte's tincture). Dose, 1 fluidram (4 c.c.).

Tinctura ferri citro-chloridi (N. F.), (tasteless tincture of iron, not reacting with tannin). Dose, 10 minims (0.6 c.c.).

Tinctura ferri pomata (N. F.), (fermented extract of apples). Dose, 1 fluidram (4 c.c.).

Uinum pruni virginianæ ferratum (N. F.). Dose, 1 fluidram (4 c.c.).

Following are some of the unofficial iron preparations more or less commonly in use:—

Ferrous lactate [$\text{Fe}(\text{C}_3\text{H}_5\text{O}_3)_2 \cdot 3\text{H}_2\text{O}$], containing about 19 per cent. of metallic iron, and occurring in greenish-white crusts made up of small needles or scales. It has a sweetish, ferruginous taste, is slowly soluble in 40 parts of cold water, freely soluble in a solution of an alkali citrate, and almost insoluble in alcohol. It is readily oxidized, and is best ordered in a dilute, syrupy preparation. Dose, 5 grains (0.3 Gm.).

Ferropyrin (ferripyrin) [$(\text{C}_{11}\text{H}_{12}\text{N}_2\text{O})_3 \cdot (\text{FeCl}_3)_2$], a compound consisting of approximately 36 per cent. of ferric chloride and 64 per cent. of antipyrin, and occurring as a yellowish-red powder, with an acid and astringent taste, soluble in 5 parts of water and in alcohol. Dose, 5 grains (0.3 Gm.). As an injection it may be used in a 1 or 1.5 per cent. solution, and as a hemostatic in a 20 per cent. solution or in dry form.

Ferric salicylate, occurring as a violet-gray powder, slightly soluble in

water. Dose, 3 to 10 grains (0.2 to 0.6 Gm.).

Ferric manganese citrate (iron and manganese citrate), occurring in brown scales, very slightly soluble in hot water. Dose, 3 to 10 grains (0.2 to 0.6 Gm.).

Soluble ferric arsenite (ferric arsenite and ammonium citrate), containing 1.4 per cent. of arsenic and about 15 to 18 per cent. of iron, and occurring in freely soluble green scales. It is suitable for subcutaneous injection. Dose, $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.).

Triferrin (ferric paranucleinate), a compound prepared by treating cows' milk casein with pepsin and precipitating the solution with a ferric salt. It contains 22 per cent. of iron, 9 per cent. of nitrogen, and 2.5 per cent. of phosphorus in organic combination, and occurs as a tasteless powder, soluble only in dilute alkalis. Dose, 5 grains (0.3 Gm.).

Arsentrierrin, an arsenoparanucleate of iron standardized to contain 0.1 per cent. of arsenic, together with about 16 per cent. of iron and 2.5 per cent. of phosphorus in organic combination. It occurs as an orange-colored, tasteless powder, soluble only in dilute alkalis. Dose, 5 grains (0.3 Gm.).

Ferratin (sodium ferrialbuminate), prepared from egg albumin and pure iron salts, and containing 6 per cent. of iron in organic combination. It occurs as a light-brown, tasteless powder, soluble in dilute alkalis. Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

Arsenoferratin (sodium arsenoferrialbuminate), similar to the preceding, but with arsenic introduced into the ferrialbuminic acid to the extent of 0.06 per cent. It occurs as a brown, tasteless powder, soluble in water. Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

Ovoferri, a 5 per cent. solution of an artificial proteid product—formed by electrolysis of serum albumin—with “masked” iron present to the extent of 0.4 per cent. The solution is reddish brown in color, slightly aromatic in taste, contains 9 per cent. of alcohol, and is incompatible with alkalies, though not with acids. Dose, 2 to 4 fluidrams (8 to 16 c.c.).

Hemogallol, an organic iron compound produced by precipitating dilute defibrinated blood with a saturated solution of pyrogallol, and occurring as a reddish-brown, insoluble, and nearly tasteless powder. Dose, 4 to 8 grains (0.25 to 0.5 Gm.).

Hemol (parahemoglobulin; reduced hemoglobin), an organic iron compound produced through the reduction of blood by shaking it with zinc dust and water, and said to contain iron to the extent of about 3 per cent. It occurs as a dark-brown, insoluble, nearly tasteless powder. Dose, 2 to 8 grains (0.12 to 0.5 Gm.).

Hemoglobin (red coloring matter of the blood), occurring as a brownish-red powder or in scales, soluble in water. Dose, 75 to 150 grains (5 to 10 Gm.) daily in wine or syrup.

MODES OF ADMINISTRATION.—Oral.—In the anemias iron should be used in a non-astringent form, viz., as reduced iron or the official pill of ferrous carbonate (Blaud’s pill). Insoluble preparations such as these are considered the most efficient therapeutically. Where it is desired to prescribe iron in solution, the soluble phosphate, the double citrate of iron and ammonium, and the double tartrate of iron and potassium are most useful. The “scale salts” of iron, *i.e.*, the salts of the vegetable acids, such as the two last mentioned, are for the most part

neutral in reaction, and can be prescribed either in neutral, alkaline or acid solutions; the scale salts containing alkaloids such as quinine and strychnine, however, cannot be prescribed in alkaline solutions, without precipitation of the alkaloids (Foreman and Gertler). The salts of the mineral acids, *e.g.*, the chloride and sulphates, are acid in reaction and should be prescribed in acid solutions. The least constipating preparations of iron are iron lactate and the double tartrate of iron and potassium (F. P. Henry). Iron need not be given oftener than three times a day, as its absorption is slow at best. Small doses of iron, such as $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015 to 0.03 Gm.), are often quite as effective as the larger amounts generally prescribed, and less apt to upset the stomach (Hare).

The official tincture of ferric chloride is a most disagreeable compound to take. A better form is the simple dilution of the official liquor ferri perchloridi to the strength of the tincture and the addition of glycerin. A formula which the author has used for a long time is:—

℞	<i>Liq. ferri perchloridi</i>35 parts,	}
	<i>Aque destil-</i>		
	<i>late</i>65 parts,	
		q. s. ad	f3x (40 c.c.).
	<i>Glycerini</i>	f3ij (8 c.c.).

The strength of this is slightly less than that of the tincture. When given with milk—10 to 30 drops in 10 to 30 drams of milk—this makes a palatable mixture, which does not attack the teeth and undoubtedly, from the strong affinity of the perchloride for proteids, contains some “masked” or changed iron differing from the perchloride. In **anemia** in general this mixture will give good results, and for that following or attending **rheumatism** it is the remedy *par excellence*. R. E. Van Gieson (N. Y. Med. Jour., April 11, 1908).

The syrup of the iodide of iron is acid in reaction, diluted hypophosphorous acid being used in its preparation. It can, however, be prescribed with Fowler's solution, as neither the acid nor alkali are enough in excess to cause precipitation; the alkali of the one neutralizes the acid of the other, forming a comparatively neutral solution. In the pill of the iodide of iron reduced iron and iodine combine to form ferrous iodide. These pills should always be freshly prepared, as the iron readily oxidizes, becoming ferric iodide, which is very difficult of assimilation. W. H. Foreman and J. H. Gertler (Jour. Ind. State Med. Assoc., Oct., 1909).

In **chlorosis** and chlorotic forms of **secondary anemia** the following recommendations as to treatment, in addition to rest and diet, are made by the author:—

When gastric irritation is not present, the following mixture may be given:—

℞ *Ferri sulphatis*. gr. iij (0.2 Gm.).
Magnesii sulphatis ʒj (4 Gm.).
Acidi sulphurici diluti ℥v (0.3 c.c.).
Syrupi aurantii. ʒj (4 c.c.).
Aquæ chloroformi .q. s. ad ʒj (30 c.c.).

M. Sig.: Three times a day after meals.

Or,

℞ *Liquoris ferri perchloridi* .. ℥xv (0.9 c.c.).
Magnesii sulphatis ʒj (4 Gm.).
Glycerini ʒj (4 c.c.).
Aquæ chloroformi .q. s. ad ʒj (30 c.c.).

M. Sig.: Three times a day after meals.

If there is slight irritability of the stomach, instead of the above acid preparations, one of the following may be given:—

℞ *Pilulæ ferri carbonatis* gr. v (0.3 Gm.).

Extracti aloes . gr. ss (0.03 Gm.).

Ft. in pil. no. j.

Sig.: Two to be taken three times a day after food.

Or,

℞ *Ferri sulphatis*

exsiccati gr. ij (0.13 Gm.).

Extracti aloes . gr. ss (0.032 Gm.).

Extracti rhamni

purshianæ ... gr. j (0.065 Gm.).

Ft. in pil. no. j.

Sig.: Three times a day after meals.

When irritability of the stomach is marked, it is advisable to give at first one of the scale preparations of iron, *e.g.*:—

℞ *Ferri et am-*

monii citratis. gr. viij (0.52 Gm.).

Sodii bicarbo-

natis gr. x (0.65 Gm.).

Syrupi aro-

matici ʒj (4 c.c.).

Aquæ chloro-

formi .q. s. ad ʒj (30 c.c.).

M. Sig.: Three times a day after meals.

A laxative pill to be taken at night.
 W. H. Willcox (Practitioner, Sept., 1913).

When the stomach rebels against inorganic iron, ferratin may be advantageously given with milk or other liquid food. It is quite suitable for children, to whom one-half the adult dose of it may readily be given. Otoferrin is another useful preparation, which is not dissociated by the gastric juice into the astringent chloride of iron and therefore fails to affect the digestion, though asserted to have in noticeable degree the property of exciting the appetite. Arsenoferratose, hemogallol and hemol are among the numerous other available preparations.

Hypodermic.—The citrate of iron is as good as, if not superior to, any other preparation for hypodermic use. The

dose generally employed is 16 minims (1 c.c.) of a 10 per cent. solution. If injected into the buttocks or muscles of the back this generally causes a sharp pain, which lasts for some time. According to Lépine this inconvenience may be avoided by using a larger quantity (40 minims—2.5 c.c.) of a weaker (4 per cent.) solution, only slight tenderness resulting. Other compounds of iron that have been used hypodermically are the citrate of iron and ammonium, the citrate of iron and manganese (15 minims or 1 c.c. of a 20 per cent. solution—Da Costa), peptonized iron (25 minims or 1.6 c.c. of a 10 per cent. solution on alternate days—Rosenthal), and iron cacodylate ($\frac{1}{2}$ to $\frac{3}{4}$ grain or 0.03 to 0.045 Gm. daily—Gilbert and Lereboullet). Ferric citrate, sodium cacodylate (containing arsenic), and strychnine sulphate are frequently injected in combination.

Intravenous.—Intravenous injections of iron have been recommended by Aporti and others for the purpose of causing a rapid and marked increase of hemoglobin percentage. The soluble double salts should alone be used, in order to prevent precipitation of the blood albumins, and the injection should be given carefully and slowly, to avoid central nervous depression. The indications for this route of introduction would appear to be quite limited. According to Grocco, the intravenous are no more efficacious than hypodermic injections.

Rectal.—Defibrinated bullock's blood has been given by enema in cases of gastric intolerance to iron. The hypodermic route is, however, to be preferred.

INCOMPATIBILITIES.—Iron is incompatible with all astringent vegetable preparations, which contain tannin

and form with iron the tannate, an intensely black compound. Calumba and quassia are the only commonly bitter tonics that may be combined with iron. Ferrous salts form green precipitates with alkalies and alkaline carbonates, lime water, magnesia, and the carbonates of calcium and magnesium. They are also incompatible with salts of mercury, silver, and gold, sulphides, chromates, and oxidizing agents such as potassium permanganate and hydrogen dioxide. Ferric salts form brown precipitates with the alkalies, alkaline earths and their carbonates, and are also incompatible with albumin, readily oxidized alkaloids such as morphine and apomorphine, sulphides, sulphates, thio-sulphates, and hypophosphites; iodides and hydriodic acid; guaiacol, salicylates, and resorcinol; guaiac, aloin, and the essential oils of cloves, cinnamon, gaultheria, and thyme. Ferric salts turn mucilage of gum arabic into a gelatinous material.

CONTRAINDICATIONS.—Internal use of iron is contraindicated in pronounced organic disease or marked irritability of the gastrointestinal mucous membrane (Knott). Autointoxication and constipation are serious impediments to the favorable action of iron compounds (Van Gieson), and should be overcome in so far as is possible before and during the use of this drug. Iron is said to be contraindicated when pulmonary hemorrhage exists or threatens, as well as in all acute pulmonary affections.

Symptoms of dyspepsia do not contraindicate the use of iron preparations, but in such case functional investigation of the stomach should precede the use of iron. Iron preparations are contraindicated in organic stomach diseases, with hyperacidity or hypersecretion, and if

existing dyspeptic troubles are increased by the use of the iron. Elsner (*Therapie der Gegenwart*, Bd. xvi, No. 6, 1905).

Iron should not be used in convalescence from enteric fever or dysentery till a considerable period has elapsed, and then only with caution. Neither should it be prescribed in the anemia accompanying intestinal irritability in tuberculous disease. Knott (*N. Y. Med. Jour.*, Nov. 28, 1908).

The use of iron may be dangerous in anemias associated with gastric symptoms, in which an examination of the stools for occult blood to exclude the presence of ulceration should always be made before prescribing it, and in anemias of tuberculous origin, in which it may activate the morbid process by increasing oxidation. Certain cases of chlorosis in association with tuberculosis are benefited, but in the average case of pulmonary tuberculosis it only serves to aggravate the condition. H. Huchard and C. Fiessinger (*Revue de therap. medico-chir.*, March 15, 1910).

Lépine advises caution in the administration of citrate of iron hypodermically where the kidneys are not sound, since even where they are healthy injections that are too concentrated may lead not only to the usual harmless polyuria, but to anuria and even nephritis. Such treatment is altogether contraindicated in anemic patients suffering from hepatic cirrhosis, epistaxis, hemorrhoids, metrorrhagia, etc., as it predisposes to hemorrhages.

PHYSIOLOGICAL ACTION.

—**Locally**, iron in the form of simple inorganic salts such as ferric chloride, acts as an astringent by reacting with the protein of the tissues—including the blood—to form a precipitate of iron albuminate. The latter soon constitutes a protective layer over the deeper tis-

ues, keeping them from being corroded by the dissociated acid portion of the salt, *e.g.*, the chloride ion. The albuminate of iron, the various forms of "organic" or undissociable iron, and the double salts of iron fail to precipitate tissue proteins, and therefore differ fundamentally in their local action from the simple iron salts, being both non-astringent and devoid of irritating properties.

The iron salts of the mineral acids are more astringent, more permanent, more easily affected by tannin and other iron precipitants, precipitate albumins more readily, are perhaps more readily absorbed, and have a more irritant effect upon the digestive organs than the salts of the vegetable acids. Foreman and Gertler (*Jour. Ind. State Med. Assoc.*, Oct., 1909).

General Effects.—Information as to the direct effects of iron upon the nervous system, circulation, etc., can be obtained only by injecting intravenously one of its non-astringent double salts, such as the double tartrate of iron and sodium, for upon administration by other routes absorption is too slow to yield acute effects and if a *simple* inorganic salt were given intravenously the blood would be clotted through precipitation of its proteins, thrombosis resulting. Experimentation in animals has shown that the direct action of iron upon the nervous system is manifested in primary irritation, followed by paralysis, of the latter. The heart and vessels are but little affected by iron, which can therefore not be said to exert an astringent effect by causing vasoconstriction. The gastrointestinal tract, however, is apparently specifically irritated by iron, the mucous membranes of this canal proving, in the experimental animals, to be the seat of marked

swelling and congestion, at times even accompanied by localized hemorrhages. Vomiting frequently occurs, and the appearance of blood in the vomitus and feces is sometimes noted. The kidneys also seem to be subject to a special unfavorable influence on the part of iron, repeated injection of small amounts of iron citrate having been found by Kobert to cause renal congestion, albuminuria and the elimination of casts. The respiration is at first accelerated by iron given intravenously, then becomes slow and difficult. Death in acute experimental iron poisoning occurs from asphyxia the result of central respiratory paralysis.

Taken by mouth, iron fails to produce any evident general effects in the normal organism, even when ingested in inorganic form and in large amount. The symptoms noted after excessive doses are those of direct gastrointestinal irritation, due to the astringency of the compounds introduced. Even upon continued use of only moderate doses, the same action is exerted, imperfect digestion, constipation and abdominal pain being the results. Iron preparations tend to augment the acid secretion of the stomach (Buzdlyan).

Absorption of ingested iron, whether in inorganic or organic form, takes place chiefly from the duodenum. It is believed that in the stomach iron, in whatever form taken, is for most part changed to the chloride (ferrous chloride—Cervello) owing to the presence of hydrochloric acid in this organ. Next it combines with protein material to form albuminates; then, entering the duodenum, is either taken up in solid form by leucocytes and the intestinal epithelial cells or absorbed in solution. The old theory that only "organic" compounds of iron—*i.e.*, those containing it

in a "masked" state so that its presence is not revealed by ordinary test reagents such as ammonium sulphide and potassium dichromate—could be absorbed from the alimentary tract, has been conclusively disproved by Kunkel, Gaule, and others. The amount permanently absorbed, however, is never very large, most of the iron ingested passing directly out with the stools and an additional considerable proportion being later re-excreted into the bowel after absorption. Animal experimentation has revealed that whereas, after the administration of iron by mouth, the duodenal epithelium as well as that of the upper part of the jejunum shows granules of iron deposited in its constituent cells, that of the stomach, the lower part of the jejunum, and the ileum does not contain such granules. The metal soon after passes into the mesenteric lymph-glands and the spleen, but several days later is found to have again migrated, being now present in largest amount in the liver and in the epithelium of the colon, including the cecum. That iron absorbed actually does become deposited for a time in the liver has been directly proven by comparing the content of iron in the livers of young animals fed on milk alone with that in the livers of others fed on milk to which iron had been added; the amount of iron was found greater in the latter series of animals than in the former. Where there is a deficiency of hemoglobin some of this iron, which may originally have been administered in inorganic form, is very probably built up in the liver to hemoglobin, an intermediate stage in this conversion being the organic iron compound known as ferratin.

In addition to its storage in the spleen and liver, iron has been observed to become deposited in the bone-marrow

upon intravenous injection of its compounds in animals. Some have attributed to it a specific power to stimulate the blood-forming organs, exemplified in the rapid improvement witnessed in cases of chlorotic anemia to which inorganic iron has been given. That the increased activity of these structures, however, is not merely the result of addition of raw material necessary for the carrying out of their hematopoietic function has not been conclusively proved.

Report of a study of the assimilation of iron contained in human milk, goats' milk, spinach, yolk of egg, and ferratin. The iron of human milk was absorbed in the proportion of 80 per cent., and 75 per cent. was assimilated. For goats' milk these figures were, respectively, 33 per cent. and 28 per cent. for the raw milk, and 15 and 9 per cent. for boiled milk. The iron of spinach was absorbed in a proportion of 64.2 per cent. and 61.5 per cent. was assimilated. The yolk of egg gave figures of 64.9 per cent. and 61.9 per cent. For ferratin the author found 23.78 per cent. for absorption and 23.39 per cent. for assimilation. Thus, the iron contained in food is more completely absorbed and is retained in larger proportion than the iron of ferruginous preparations. Krasnogorsky (*Jahrb. f. Kinderheilk.*, Bd. xiv, S. 651, 1906).

Report of experiments leading to the following conclusions: All combinations of iron, whether administered in food or in medicine, on reaching the stomach, are to a certain extent changed into an ionized form of iron. Simultaneously any protein component of the ferruginous compound is converted into diffusible peptone. It appears probable that the loosely combined iron with the peptone is directly absorbed as alkaline iron-peptone; the loose combination of the iron with the peptone hinders the precipitation of the

iron as oxyhydrate, a compound which is non-absorbable. The practical outcome of these experiments is that it is immaterial in what form iron is administered; preference may be given to the preparation which appears to be best suited to the stomach. H. Schirokauer (*Zeit. f. klin. Med.*; *Med. Chronicle*, Nov., 1909).

In all persons there is an excess of iron in the blood over that which is combined with hemoglobin; normally, such excess bears a ratio, to the total amount of iron, of average 4.2 to 1. In pernicious anemia the ratio is markedly elevated, approaching 2 to 1. P. H. C. Fowell (*Quarterly Jour. Med.*, vol. vi, p. 179, 1912).

The writers found, by macroscopical chemical methods, that in pernicious anemia there is a constant and marked siderosis or deposit of iron in the spleen and liver. In pulmonary tuberculosis siderosis is constant in the spleen, but very slight or absent in the liver, even though the latter is cirrhotic. In non-tuberculous cirrhosis there is siderosis in both spleen and liver, usually predominating in the latter. In cardiac and renal affections the spleen is usually, and the liver always, free from iron pigment. In general, the spleen and liver are the chief organs showing siderosis, though sometimes the pancreas, thyroid, and lymphatic glands also contain iron pigment. J. Chalier, L. Nové-Josserand, and Boulud (*Lyon méd.*, March 23, 1913).

In a patient who suffered from an extensive hemorrhagic encephalitis in the cortex the iron reaction was not demonstrated in the cortical ganglion cells in this case, but was obtained in a cell reaction in the plasma-like cells of the pia-arachnoid and in the elastic coats of the smaller cortical arteries. McCarthy (*Amer. Jour. Med. Sci.*, March, 1914).

The commercial "peptonized" iron (a mixture of ferric oxide and peptone) and other similar preparations have

been asserted to stimulate the leucocytes to invade the epithelial layer of the intestinal villi. This fact may have some relation to the absorption of the drug.

Excretion of absorbed iron, as already intimated, is a relatively slow process, and takes place almost exclusively through the epithelium of the large intestine. No increase over the very small amount normally excreted through the kidneys is observable after administration of additional iron medicinally. Neither does it pass out from the liver into the intestinal tract with the bile, whence it is inferred that whatever iron is to be excreted is conveyed to the intestinal epithelium through the blood-stream. According to Hochhaus and Quinke, excretion of iron previously accumulated in the submucous tissue of the large intestine is probably effected through the extrusion of iron-laden leucocytes.

The amount of iron normally absorbed from the food, as well as the quantity excreted daily, have both been shown to be very small. While the total weight of iron in the body of an adult is about 40 to 55 grains, the amount absorbed from the food each day is only about $\frac{1}{12}$ to $\frac{1}{6}$ grain. Stockman found $\frac{1}{8}$ grain in the diet of a young lady living in the ordinary way and taking an average amount of food, while in that of 2 chlorotic girls who ate very little the quantity averaged $\frac{1}{25}$ grain a day. The total excreted daily by all channels is correspondingly small—less than $\frac{1}{10}$ grain, of which only $\frac{1}{120}$ to $\frac{1}{40}$ grain passes out in the urine.

In experiments performed by Skvortzoff to ascertain the effect of medicinal administration of iron on nitrogenous metabolism in the healthy organism, no pronounced action in this direction was

observed. Daily doses* of 5 to $7\frac{1}{2}$ grains caused a very slight decrease in the assimilation of the nitrogenous portions of the food.

UNTOWARD EFFECTS AND POISONING.—Unfavorable results from the use of iron are practically limited to gastrointestinal irritation, the production of a sensation of fullness and abnormal warmth in the head, or frontal headache, and occasionally, epistaxis or hemorrhage from the throat or lungs, particularly in the presence of lung tuberculosis. Constipation, indigestion, and gastric pain are the most frequent of the gastrointestinal disturbances produced. Tachycardia, precordial discomfort, insomnia, and an acnei-form or erythematous itching eruption are other conditions that have been attributed to the administration of iron. Bladder irritation causing frequent micturition and, in children, enuresis are at times caused by it.

Serious acute poisoning from iron is not likely to occur unless it be from intravenous injection, absorption by other routes being too slow to permit of dangerous general toxic effects. Lépine reports, however, that a little over 45 grains (3 Gm.) of the citrate injected hypodermically, has produced vomiting, fever, and malaise lasting several hours. Robert has described a pathological condition which he terms the "metallic kidney," the result of an attempt of the kidneys to eliminate an excess of iron in the blood, and which consists of an accumulation of the metal in the epithelial cells of the convoluted tubules; this may be so marked as to produce evident obstruction in the tubular lumen.

The symptoms of martial poisoning or siderismus are those of a distressing artificial plethora, aggravated by the coexisting constipation. There is violent arterial pulsation—most felt

in the carotids, with distressing palpitation, bursting headache, etc.—even fever, intense flushing of the face, injected conjunctivæ, and tinnitus aurium. There is epigastric tenderness, with a feeling of weight and dull pain. The tongue is darkly furrowed, the appetite impaired or lost, and there are irregular, colicky spasms. Where the gastrointestinal mucous membrane had previously been in a very irritable—congested or ulcerated—condition, the additional irritation of iron gives rise to continuous diarrhea. J. Knott (N. Y. Med. Jour., Nov. 28, 1908).

Pronounced and even lethal gastroenteritis may result from ingestion of excessive amounts of the more irritating iron salts such as Monsel's salt and ferric chloride.

Morgenstern, in a detailed study of the effects of various iron preparations on the teeth, found that ferratin, iron albuminate, reduced iron, and a solution of the saccharate of iron and manganese had no deleterious action whatever, that ferric citrate and the waters of some chalybeate springs exerted a very mild caustic effect and that tincture of ferric chloride, ferrous sulphate, ferrous lactate, and the waters of certain other iron-bearing springs caused a more or less marked decalcification of the teeth and imparted to them a brown color. The chloride and iodide of iron were found particularly prone to awaken toothache, producing this effect in a few days, where predisposition already exists, even in a 1:1000 solution.

Prophylaxis and Treatment.—The most important prophylactic measure is to overcome constipation both before and during the administration of iron by the use of laxative remedies. The latter, *e.g.*, aloes, are sometimes given in the same preparation with the iron,

but as this tends to accelerate unduly the passage of the iron itself out of the intestinal tract, it is preferable to administer the laxative separately.

In the event of intense irritation of the mucous membranes by iron salts, baking soda, soap, or tannic acid are useful as antidotes.

Injury to the teeth from iron may be avoided either by employing only the compounds known to be inoffensive in this particular, by ordering the solution to be taken through a glass tube, or, if a solid preparation is to be used, by prescribing it in gelatin-coated pills or capsules.

THERAPEUTICS.—The most important indication for the exhibition of iron is the presence of certain forms of **anemia**, viz., those in which the hemoglobin of the blood is present in less amount than normal. Moreover, this applies particularly in those varieties in which the hemoglobin index, or relation of hemoglobin percentage to percentage of red corpuscles, is low, *i.e.*, in **chlorosis** and chlorotic forms of anemia, such as are commonly met with in tuberculosis, syphilis, malignant disease and many other conditions. Anemias, the result of hemorrhage, chronic poisoning by lead, mercury, and arsenic, the presence of parasites in the intestine, or the pullulation of malarial organisms in the blood are also benefited by iron, though special attention must be paid in these conditions to removal of the original cause of the anemia.

Hemoglobin may be deficient either because of defective hematopoiesis (formation of blood) or by reason of excessive hemolysis (destruction or breaking up of the red corpuscles). The best results with iron are obtained in cases belonging to the former class. In **progressive pernicious anemia**,

however, iron is believed frequently to be productive of some good when given in combination with arsenic.

Most cases of chlorosis are completely cured by iron, the condition of the blood being not alone corrected, but subsidiary phenomena such as edema, gastric disorder, and amenorrhea caused to disappear indirectly owing to the restoration of the hemoglobin to an adequate level. According to A. Hofmann the iron acts by stimulating the process of blood-formation in the bone-marrow, although in normal animals (not those rendered anemic by blood-letting) he found only some increase in the number of red cells circulating, and of the fat in the bone-marrow, without any increase of cell formation in the marrow. Where hemoglobin is deficient, according to this investigator, iron accelerates the ripening and entrance into the circulation as non-nucleated cells of the young erythrocytes produced in the bone-marrow.

Treatment with iron ought to be continued, as a rule, from six weeks to two months, in order to procure all its useful effects. All three types of anemia—toxic, infectious, and hemorrhagic—should be treated that length of time. In **toxic anemia**, such as **chlorosis**, two essentials precede the prescription of iron—the restoration of the gastric functions by the use of diet and absorbent powders, and the regularization of the bowels. Laxatives should be ordered, to be combined later with iron. The following formulæ are useful:—

℞ *Iron and potassium tartrate* gr. iss (0.09 Gm.).
Pulverized rhubarb,
Heavy magnesia,
 of each gr. j (0.06 Gm.).
Extract of cinchona ... gr. iss (0.09 Gm.).

M. et ft. pil. no. j. Sig.: Two to be taken before meals.

℞ *Ferrous carbonate* gr. iss (0.09 Gm.).
Aloes gr. ⅓ (0.02 Gm.).
Extract of rhubarb gr. j (0.06 Gm.).

M. et ft. pil. no. j. Sig.: Two to be taken before meals.

℞ *Iron and potassium tartrate,*
Extract of rhubarb,
Extract of gentian,
 of each gr. lxxv (5 Gm.).
Extract of nux vomica. gr. viij (0.5 Gm.).

M. et ft. pil. no. vj. Sig.: Two to be taken at meals.

Metrorrhagia due to anemia in young girls can often be stopped by giving the following in pill form:—

℞ *Ferrous carbonate* gr. iss (0.09 Gm.).
Ergotin gr. j (0.06 Gm.).
Quinine hydrobromide . gr. ⅓ (0.01 Gm.).
Extract of belladonna-leaves gr. ½ (0.005 Gm.).

M. et ft. pil. no. j. Sig.: Two to be taken before meals.

Huchard and Fiessinger (*La thérap. en vingt médicaments*; N. Y. Med. Jour., Feb. 28, 1911).

As for the dose of iron required in anemias, small amounts such as 1 or 2 grains (0.06 or 0.12 Gm.) of reduced iron or the carbonate three times daily are generally sufficient, any larger quantity being useless to the organism and merely tending to increase gastrointestinal irritation. Where the tongue is heavily coated, the breath offensive, and the bowels constipated, the administration of iron should be preceded by a purge (Henry). It is to be borne in mind, too, that where gastric hyperacidity already exists, iron may aggravate the dyspeptic symptoms, unless the digestive affection has been set right before it is ordered (Buzdygan). Where

hydrochloric acid secretion is, on the other hand, diminished, iron is often of service in improving the appetite and gastric functions. For these purposes ferrous sulphate is one of the best preparations to use, though in some cases the stomach may prove intolerant of it. Where feeble digestion and constipation coexist the addition of aloes to iron, as in the *Pilula aloes et ferri*, is recommended. A combination introduced by Squire under the appellation "Mistura ferri laxans" may also be ordered under these circumstances.

R Ferri sulphatis gr. ij (0.12 Gm.).
Magnesii sulphatis .. 3j (4 Gm.).
Acidi sulphurici diluti. miiij (0.2 c.c.).
Spiritus chloroformi. mxx (1.25 c.c.).
Aque menthae piper-
itaq. s. ad f3j (30 c.c.).—M.

In cases of anemia in which a prompt and intense effect of iron is desired, or where iron is not tolerated by the gastrointestinal tract, hypodermic administration has proven of marked efficacy. For further information concerning methods of prescribing iron the reader is referred to the section on MODES OF ADMINISTRATION.

Neuralgia due to anemia is greatly benefited by large doses of the tincture of ferric chloride (30 minims—2 c.c.) or of the saccharated carbonate (20 grains—1.3 Gm.), given three times daily. Ferripyrin, a red crystalline compound of iron with antipyrin, might also be used in doses of 4 to 8 grains (0.25 to 0.5 Gm.) in these cases. **Amenorrhea** dependent upon anemia is benefited by the citrate of iron, either alone or combined with strychnine. The **dysmenorrhea** often occurring in anemic young women is also overcome by iron (Parsons).

In the anemia of **malaria**, if the spleen is enlarged and the portal cir-

culatation engorged, a purge, *e.g.*, compound jalap powder, with or without podophyllin, should precede the administration of iron. According to Schussler, Prussian blue (ferric ferrocyanide) possesses antiperiodic as well as tonic properties, and may be substituted for quinine in doses of 5 grains (0.3 Gm.) every three hours where the former fails.

The hemoglobin-regenerating action of iron is best availed of by giving insoluble preparations, inasmuch as the researches of Dumont have served to indicate that iron is absorbed by phagocytes, and those of Fleig, that insoluble iron provokes this process of phagocytosis more actively than the soluble preparations.

A second effect of the administration of iron is to stimulate oxidation. Iron also directly excites the glands of the stomach, and has a distinct antiseptic action in the intestinal tract. Hence preparations of iron should not be given in cases of hyperchlorhydria, but rather in cases of chloroanemia associated with intestinal fermentation.

In **anemia due to lead**, iron is useful in association with the iodides. The protiodide of iron is valuable in this condition. In anemia **following acute infections**, such as **acute articular rheumatism**, **pneumonia**, and **septic states**, the physician prescribing iron should be on the watch for signs of tuberculosis. In malarial anemia, Jaccoud recommends the use of the tartrate of iron and potassium in combination with extract of cinchona in large doses. Posthemorrhagic anemias should not always be treated with iron, since the administration of this drug may provoke hemoptysis or hematemesis. It may be given, however, **after hemorrhage** resulting from trauma, when the flow of blood has been checked. H. Huchard and C. Fiesinger (*Revue de thérap. médico-chir.*, March 15, 1910).

In anemia accompanying **syphilis** the use of the iodide of iron is indicated. F. P. Henry also recommends the following:—

℞ *Tr. ferri chloridi* ... f̄ss (15 c.c.).
Hydrargyri chloridi
corrosivi gr. j (0.06 Gm.).
Glycerini f̄ss (15 c.c.).
Aque f̄ij (90 c.c.).

M. Sig.: One teaspoonful in water thrice daily after meals.

Commendation of the acetates, citrates, tartrates, and malates of iron and their double salts. Iron and potassium tartrate is one of our best remedies in **postsyphilitic anemia**. The following mixture has been used by the author for many years with good results:—

℞ *Ferri et ammo-*
nii citratis 3v (20 Gm.).
Aque cinnamomi,
lini angelice ...āā f̄vij (210 c.c.).

M.

Two teaspoonfuls of this equal about 5 grains of the iron salt. It is agreeable to the taste, acceptable to the digestive organs, and rarely fails to give results. R. E. Van Gieson N. Y. Med. Jour., April 11, 1908).

Similarly in the various manifestations of scrofula, especially **tuberculous adenitis**, as well as in **rachitis**, the iodide of iron, given in syrup form, is frequently of considerable benefit. It is best to begin with small doses, the amount being then increased as tolerance is established. In rachitis, a combination of the phosphates of iron and calcium is preferred by some to the iodide. Addition of iron to codliver oil has been stated to increase the efficiency of the former in these cases.

Not all anemias call for iron, nor all stages of the condition. In **chlorosis** it is often the emetic effect of iron sulphate that is of value. The author has treated many patients satisfactorily with 20-grain (1.3 Gm.) doses of zinc sulphate taken fasting

on successive mornings. Irrigation of the stomach with a hot normal saline solution or compound senna mixture will produce the same effect as zinc sulphate. During convalescence or when the derangement has subsided after severe indigestion, the tongue being pale, indented, and silvery, the acid preparations of iron are especially indicated. **Rickets** and **splenic anemia** show improvement most quickly with acid preparations—ferrous chloride or sulphate. In **tuberculous bone or gland disease** in children, the author has obtained the best results from a mixture of the tincture of ferric chloride, from 5 to 10 drops (0.3 to 0.6 c.c.), with the B. P. solution (½ grain to the ounce) of mercury perchloride, from 10 to 20 drops (0.6 to 1.2 c.c.), taken perseveringly three times a day for months. In mucous disease, the best form is the tartrate (B. P.) or the ammoniicitrate, given with alkali in a bitter infusion. The pernitrate in small doses, 1 to 2 minims (0.06 to 0.12 c.c.) of the solution, is a safe and efficient remedy for children in **convalescence from chronic diarrhea**. It has an invigorating effect on all mucous membranes, and is often useful in **chronic bronchitis**, **menorrhagia**, and **leucorrhea**. The perchloride has a diuretic action useful in **albuminuria**, especially at the end of acute Bright's disease, when the albumin is slow to disappear. The author prefers Basham's mixture. Smith (Brit. Med. Jour., Oct. 17, 1908).

In **pulmonary tuberculosis** iron is generally considered to be contraindicated where hemoptysis threatens. Combined administration of digitalis and iron has, however, been recommended to control the hectic fever in this affection, 5 drops of tincture of digitalis and 10 drops of tincture of ferric chloride being given three or four times daily.

In young anemic persons suffering from incipient **tuberculosis** and not

subject to hemoptysis iron is not contraindicated, but one must be cautious in the selection of the preparations used. The organic preparations should be preferred, more especially ferratin or arsenoferratose and hemoglobin. Care should be taken to see that the iron does not raise the blood-pressure. Given at the right moment and under daily observation of the patient, the iron may tide over a critical period. A. G. Apostolides (*Folia Therap.*, July, 1908).

In **heart disease** iron is undoubtedly of considerable value where anemia exists, whether the cardiac affection be of valvular or musculo-degenerative nature. Among valvular affections, **aortic and mitral insufficiencies** appear to benefit most from its use. Special care is necessary, however, to avoid inducing gastric disturbance and constipation with it—effects particularly likely to be noted where venous stasis already exists.

In **chronic nephritis** iron in the form of Basham's mixture (*Liquor ferri et ammonii acetatis*), 2 to 4 fluidrams (8 to 16 c.c.) three or four times daily, has for many years been freely used. As pointed out by Tyson, however, this mixture has no direct curative influence on the renal condition, is not diuretic, and should be used only with the purpose of overcoming anemia. In cases that are not anemic, iron is likely to do more harm than good owing to its tendency to lock up the bowels. In **chronic parenchymatous nephritis**, the form in which iron is most useful, Tyson's practice is to determine the proper dose by examination of the stools; if these are decidedly blackened, too much is being given. In chronic interstitial nephritis and acute forms of nephritis, iron is rarely, if ever, indicated, though during convalescence after **acute nephritis** it

is often of considerable value. Tincture of ferric chloride may be given instead of Basham's mixture if desired.

In **erysipelas** iron has been credited by some with almost specific properties, though others have failed to obtain corresponding results. The plan generally followed is to give large doses of the tincture of ferric chloride (10 to 60 minims—0.6 to 4 c.c.), well diluted, every four hours. Salicylate of iron has in late years, however, found much favor as a substitute for the tincture.

Mixture of the tincture of perchloride of iron and sodium salicylate recommended for **erysipelas**, **acute tonsillitis**, in some cases of **croupous pneumonia**, **puerperal sepsis**, **sublingual adenitis**, **rheumatic endocarditis** with hyperpyrexia, etc. It acts as a powerful febrifuge even in small doses and does not produce diaphoresis. Of 50 cases of erysipelas, none lasted for more than forty-eight hours after the commencement of the administration, and the headache and general malaise disappeared at the end of eight hours; the only supplementary medical treatment was an evening dose of 1 to 2 grains (0.06 to 0.12 Gm) of calomel or a saline morning aperient. The mixture employed was made up by dissolving 1 dram (4 Gm.) of sodium salicylate in 2 ounces (60 c.c.) of water, which was added to 2 drams (8 c.c.) of tincture ferric chloride; potassium chlorate $\frac{1}{2}$ dram (2 c.c.); glycerin, $\frac{1}{2}$ ounce (15 c.c.), and water, to 3 ounces (90 c.c.). The whole was made up to 8 ounces (240 c.c.), the dose being 2 tablespoonfuls every three or four hours. In acute tonsillitis resolution and cure occurred generally in twenty-four to forty-eight hours, and even in cases where suppuration had occurred the pus was rapidly absorbed. Along with the internal use of the salicylate of iron the author employed a gargle of iodine solution, $7\frac{1}{2}$ to 30 minims (0.45 to 1.8 c.c.) of tincture of iodine

to the pint of water, used four-hourly. It is inadvisable to continue the use of the iodine preparation for the throat or nose longer than three days, as it may produce an inflammatory condition (which a weak alum sulphate solution will relieve). F. J. Gray (Edinburgh Med. Jour., Nov., 1905).

In **diphtheria** the tincture of the chloride has been used, both internally and locally, with asserted marked benefit, especially as a systemic "supportive." Whittla considers iron of special value in cases complicated with streptococcic or other septic infection, and refers to the following as a good formula, suitable for a child about 4 years of age:—

R. *Tinctura ferri*

chloridi fʒj (4 c.c.).
Potassii chloratis.. gr. xxxv (2 Gm.).
Glycerini fʒvj (24 c.c.).
Aquæ chloroformi,
 q. s. ad fʒiv (120 c.c.).

M. Sig.: Dessertspoonful every four hours.

Quinine or strychnine might likewise be combined with the iron. The use of potassium chlorate is by some objected to on the ground that it induces degenerative changes in the renal tissue.

Attention called to the great value of perchloride of iron in **blood-poisoning, erysipelas, scarlet fever, diphtheria**, etc. Its beneficial effects are ascribed by the author to the presence of free chlorine. The remedy must be carefully used; large doses not infrequently increase fever and set up intestinal irritation, palpitation, and headache. Latham (Lancet, Nov. 19, 1904).

In **epilepsy** and **chorea** in weak, anemic subjects the use of ferrous bromide in doses of 5 to 20 grains (0.3 to 1.3 Gm.) has been recommended. Hequet reported that of 25 cases of **spermatorrhea** treated with 3- to 5-grain

(0.2 to 0.3 Gm.) doses of ferric bromide, only 2 were unrelieved.

Ricord termed the tartrate of iron and potassium "the born enemy of **phagedena**," and used it both internally and locally in this complication of **chancroid**.

Local Uses.—The strong astringent properties of some of the iron salts render them highly efficient as styptics. Monsel's solution (*Liquor ferri subsulphatis*) and the official aqueous solution of ferric chloride (*Liquor ferri chloridi*) are the preparations chiefly used. In **gastric hemorrhage** 1 to 5 minims of the former solution, diluted in ice-water and repeated as required, will generally be followed by relief. In **epistaxis** a weak dilution of Monsel's solution (fʒj-fʒviii—4-240 c.c.) has been advised, to be used in the form of a spray.

The disadvantage as styptics of the iron salts in common use is that they are caustic, owing to the free acid radical (chloride or sulphate) left upon combination of the iron with the tissues. These salts tend to cause the formation of a superficial slough or eschar and should therefore never be applied for hemostatic purposes to aseptic wounds, especially since the dense, adherent clot formed by the iron offers an excellent nidus for the lodgment and reproduction of bacteria. The obstruction formed by iron to the outflow of blood is not a true clot, as it contains no fibrin and consists merely of iron albuminate which blocks up the open vessels. This being the case, iron salts are powerless to control hemorrhage unless they can be brought directly to the bleeding point.

Ferripyrin, a combination of iron with antipyrin, has been recommended as being free from the caustic effects of

the other salts, while preserving the hemostatic properties of each of its constituents. Either the powder or a 20 per cent. solution of this drug may be applied; in the latter case cotton tampons are saturated with the solution and applied to the bleeding surface. **Epi-staxis**, among other conditions, has been relieved by the introduction of small tampons soaked in ferripyrrin (Hedderich).

In **intestinal hemorrhage** iron is usually of but little utility, as it probably becomes converted into the inert sulphide during its descent in the alimentary canal. The administration of hard pills containing 3 grains (0.2 Gm.) of iron subsulphate has, however, been advised. In bleeding **hemorrhoids** the loss of blood may be diminished or even arrested by washing the protruding masses with Monsel's solution. The tumors should be well oiled before they are returned. Iron in the form of Monsel's salt (ferric subsulphate) can likewise be added to the antipruritic and astringent ointments frequently prescribed for hemorrhoids, where the bleeding persists notwithstanding the use of other drugs.

Hemorrhage following **leech-bites** and **tooth extraction** can readily be arrested with Monsel's solution.

Internal use of iron to arrest hemorrhage in parts of the organism other than the alimentary tract, *e.g.*, in **metrorrhagia**, **hemorrhage post abortum**, **purpura**, **hemophilia**, etc., has been advocated, but is not likely to prove efficient unless anemia underlies the

hemorrhagic manifestations. In **hemoglobinuria** Baccelli has found the administration of iron subsulphate, in conjunction with oxygen inhalations and hygienic measures, most useful.

The astringent properties of iron are availed of for purposes other than arrest of hemorrhage in, *e.g.*, **diphtheria**, in which Monsel's solution may be applied to the tonsils and pharynx, either pure or diluted with 2 or 3 parts of glycerin, to constrict the tissues and limit extension of the exudate. In **follicular tonsillitis** and in **pharyngitis** the same procedure gives gratifying results, though some degree of pain may follow the application.

Fissured nipples can be caused to heal by brushing with Monsel's solution diluted with 3 parts of glycerin. The undiluted solution will cause **syphilitic vegetations of the glans and prepuce** to disappear. Ferripyrrin in 1 to 1½ per cent. solution has been recommended by Hedderich as an astringent injection in **gonococcal urethritis**.

Roundworms (ascarides) can be removed by injections of a weak dilution of the tincture of ferric chloride.

The use of freshly precipitated ferric hydroxide as an antidote in **arsenic poisoning** was mentioned in the section on PREPARATIONS AND DOSE.

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IVY POISONING. See DERMATITIS VENENATA.

J

JABORANDI. See PILOCARPUS.

JALAP.—Jalap (*Jalapa*, U. S. P.), named from Jalapa, a city of Mexico, is the dried tuberous root of the *Ipomæa Jalapa* (*Exogonium purga* or *Ipomæa purga*), a vine of the family Convolvulaceæ, indigenous to Mexico, and also grown in Jamaica and India. The root has a peculiar smoky odor, and an acrid, sweetish, and nauseous taste. As seen in the shops, it is often in a yellowish-gray powder, though originally imported in large, irregularly globular root masses or in pieces. The active principle of jalap is a resin, present in amounts varying from 8 to 12 per cent., and which is divisible into two portions: one, *convolvulin* or *jalapurgin* (constituting 85 to 90 per cent. of the resin), a glucosid which is hard and insoluble in ether, but soluble in alcohol and chloroform and partly soluble in water; the other *jalapin*, likewise a glucosid, soft and soluble in ether and alcohol. Both are active purges, but convolvulin is more potent (dose, 1 to 3 grains—0.065 to 0.2 Gm.) than jalapin (dose, 2 to 5 grains—0.125 to 0.3 Gm.). Jalap also contains about 18 per cent. each of starch and sugar as well as calcium oxalate and gum. Jalapin is considered identical with scammonin, and, as such, constitutes a large portion of the gum-resin known as scammony.

PREPARATIONS AND DOSE.—*Jalapa*, U. S. P. (jalap), required to contain not less than 8 per cent. of total resin, but not more than 1.5 per cent. of ether-soluble resin. Dose, 15 grains (1 Gm.).

Resina jalapæ, U. S. P. (resin of jalap), made by percolation of jalap with alcohol, precipitation of the percolate in water, and evaporation of the precipitate to dryness. It consists of yellow to brown masses or a powder, has a somewhat acrid taste, and is insoluble in water and oils, but soluble in alcohol. Dose, 2 grains (0.125 Gm.).

Pulvis jalapæ compositus, U. S. P. (compound jalap powder), consisting of jalap, 35 parts, and potassium bitartrate, 65 parts. Dose, 30 grains (2 Gm.).

Fluidextractum jalapæ, N. F. (fluidextract of jalap). Dose, 15 minims (1 c.c.).

Tinctura jalapæ, N. F. (tincture of jalap), of 20 per cent. strength. Dose, 1 fluidram (4 c.c.).

Tinctura jalapæ composita, N. F. (compound tincture of jalap), each fluidram (4 c.c.) of which represents 7½ grains (0.5 Gm.) of jalap and 2 grains (0.125 Gm.) of scammony. Dose, 1 fluidram (4 c.c.).

Jalap is also contained in the *Pilulæ catharticæ compositæ* and *Pilulæ catharticæ vegetabilis* (U. S. P.), for the composition of which see COLOCYNTH.

PHYSIOLOGICAL ACTION.—Jalap acts as a powerful hydragogue cathartic. Gastrointestinal irritation is produced by excessive doses. It is also irritating to other mucous membranes, *e.g.*, when snuffed into the nostrils as a fine powder. According to Vulpian and Moreau, when applied to the exposed colon it gives rise to active peristaltic motion. The resin was detected by Müller in the blood of dogs given jalap, but cannot be found in the urine or feces, and is therefore believed to be oxidized in the body. Jalap passes into the milk of wet-nurses and purges their nurslings.

POISONING.—Jalap when taken in overdose acts as an irritant to the alimentary canal, the symptoms being copious watery stools, tormina, and tenesmus, at times accompanied by nausea and vomiting. The treatment of poisoning consists in the evacuation of the retained jalap with the **stomach-tube** and the use of **demulcent drinks**.

THERAPEUTICS.—Jalap, which produces large, watery stools, is used principally to relieve dropsical effusions, **anasarca**, and **ascites** in cases of **heart disease**, **nephritis**, or **hepatic cirrhosis**. The resin, which is the active constituent, is almost tasteless, and, as the dose is small, it may be readily given to children in doses of ¼ to ½ grain (0.015 to 0.03 Gm.). The maximum dose for adults is 7½ grains (0.5 Gm.). According to Debove and Pouchet, the resin is less effective than powdered jalap, given with honey. The preparation most frequently used, however, is the compound jalap powder, which possesses some diuretic power in addition to its property of causing copious watery

bowel evacuations. If necessary, it may be given daily for some time without harm. In **pulmonary congestion and distended right heart** with cyanosis and dyspnea (so-called "**cardiac asthma**"), a teaspoonful of compound jalap powder will give relief. In **acute fibrinous pleurisy** $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of the same preparation may be advantageously given at bedtime to overcome abdominal distention and the resulting dyspnea (Capps). In **hemorrhoids** it does not cause irritation, but, on the contrary, brings relief by emptying the vessels above, and clearing out the liver. As an active purge in cases where the liver is torpid, a combination of jalap with calomel is extremely active, efficiently removing portal congestion. The official compound cathartic pills include these two agents among their constituents (see **COLOCYNTH**). In **cerebral hyperemia** the hydragogue action of jalap is also useful. To avoid griping, a little hyoscyamus or belladonna may be combined with it:—

℞ *Jalapæ pulveris*,
Hydrargyri chloridi
mitisãã gr. v (0.3 Gm.).
Belladonnæ foliorum
pulveris gr. ss (0.03 Gm.).
 Ft. in cachetum no. j.

Jalap acts generally in two to four hours. Its use is contraindicated in inflammatory states of the alimentary canal. S.

JAMBUL.—Jambul is an East Indian tree that belongs to the family Myrtaceæ. It is the *Eugenia jambolana* of Lamarek or the *Syzygium jambolana* of de Candolle. From the fruits, by alcoholic fermentation, a liquor is obtained, the *jambava* of the Hindoos. This liquor, allowed to acidify, turns into a vinegar, of an agreeable taste, and is extensively used by them as a stomachic, carminative, and diuretic. The bark is reddish gray, and has a rather bitter, pungent taste. The fruit is purple, of the size of an olive, and very astringent. The seeds are very hard, cylindrical in shape, grayish black, about half an inch long, and almost tasteless.

PREPARATIONS AND DOSE.—Jambul is not official. The preparation generally employed is a powder made from the bark, or, better, from the seeds, which

may be given in doses varying from 5 grains to 1 dram (0.3 to 4 Gm.). Some observers recommend that as much as 75 to 150 grains (5 to 10 Gm.) be given in the twenty-four hours.

A fluidextract made from the seeds is more conveniently administered, and can be given in graded doses of from 10 to 30 minims (0.6 to 2 c.c.), according to the results obtained. A fluidextract of the bark has also been used by Vix in doses of 1 to 5 fluidrams (4 to 20 c.c.) several times a day, as well as the whole fruit, preserved in alcohol. The pulp of the dried fruit is not considered of any value. The fluidextract of the bark is both more palatable and less expensive than that made from the seeds (Vix).

PHYSIOLOGICAL ACTION.—Jambul in the first place acts as a gastric tonic, through a principle that resides in the seeds, the bark, and the fruit of the plant. Its properties are strongest in the seeds, which, according to the analysis of Elborne, contain an essential oil, chlorophyll, a resin, gallic acid, albumin, colored extractive matter, and an insoluble residue. These grains, as well as the bark and the rind of the fruit, appear to contain a glucosid, to which the physiological effects of the plant may be due, but this, as yet, has not been isolated.

The property for which jambul has been most employed is that of diminishing glycosuria. Groeser submitted dogs to the conjoined action of phloridzin (which, as is well known, causes an artificial glycosuria) and an extract of jambul, and found that under these conditions the sugar of the urine was invariably diminished almost to one-half that excreted under the action of the phloridzin alone, and also that the duration of the glycosuria was considerably lessened. In pushing his experiments further in order to determine the toxicity of jambul, Groeser noticed that as much as 5 drams of the drug could be given to a dog in a day without producing any harmful effects, with the exception of some diarrhea (Egasse). It has also been shown *in vitro* that the production of sugar from starch by diastase is markedly impeded in the presence of jambul.

THERAPEUTICS.—The juice of the fresh bark, mixed with goats' milk, is said

to be useful as an astringent in the treatment of **infantile diarrhea**. It has also been used in the form of gargles and lotions.

Jambul has been especially extolled, however, in the treatment of **diabetes mellitus**. The natives of India and the English physicians were the first to speak in favor of it, the former asserting, in fact, that no dieting was necessary in this disease, since the jambul prevented the possibility of sugar excretion in the urine. Since that time the drug has been used by various clinicians, in Western countries, on the whole with but a moderate degree of success. The consensus of opinion appears to be that the drug is effective only in a certain proportion of cases, chiefly in those of a mild type. According to Vix, it may be of great service in procuring symptomatic relief. Von Noorden speaks of its effects as somewhat resembling those of the salicylates. The drug has also been used in **diabetes insipidus**, with asserted benefit. It should be taken after meals; otherwise, in sensitive patients, nausea may be produced. S.

JAPANESE RIVER FEVER, OR SHIMA MUSHI.—This disease, also known as "flood fever," occurs in the hemp districts on the banks of two rivers of Japan, the Shinanogawa and Omonagawa. It is ascribed to the bite of the Kedani larval mite, resembling, morphologically at least, *Leptus autumnalis*. The bite is followed by an eschar, which ulcerates and then gives rise to fever, an exanthematous eruption, lymphangitis, conjunctivitis, and bronchitis. It ends fatally in about 15 per cent. of the cases.

TREATMENT.—The disease is prevented by avoiding the districts to which it seems to be restricted, but if traveling in the infected hemp countries is necessary strict personal cleanliness aids greatly to prevent infection. The only remedial measures which have shown any value are **sodium salicylate** and **quinine**, preferably the **hydrochloride**. Locally, **iodine ointment** upon the bites or under the eschars is sometimes useful. The general phenomena and complications call for appropriate measures. (See **CONJUNCTIVA**, **BRONCHITIS**, etc.) S.

JAUNDICE. See **LIVER, DISEASES OF.**

JAWS, INJURIES AND DISEASES OF. See **MOUTH, LIPS AND JAWS, DISEASES OF.**

JEQUIRITY.—Jequirity is the name given in Brazil to the seeds of the *Abrus precatorius*, or wild licorice, a climbing shrub of the family Leguminosæ, indigenous to India, but now naturalized elsewhere in the tropics. The seeds, or beans (prayer beads; crab's eyes; jumble beads), are about $\frac{1}{8}$ inch in diameter, nearly spherical, of a bright-red color, with a black spot at the hilum, are inodorous, and have a slight bean-like taste. In India they are employed as a weight standard (about $1\frac{1}{2}$ grains). Though inert when taken whole into the stomach (Warden and Waddell), the seeds contain an albuminoid active principle, *abrin*, closely resembling snake-venom in its action, and also *abric acid*. Abrin occurs as a yellowish-white powder, soluble in a solution of sodium chloride and in glycerin. It is precipitated from aqueous and glycerin solutions by alcohol. The root of the plant is official in the Pharmacopœia of India as a substitute for licorice.

PHYSIOLOGICAL ACTION.—The poisonous and irritant properties of jequirity are due to the contained abrin, which has been termed a "vegetable agglutinin" and is a powerful cardiac depressant. Roemer found that the dose of abrin required to kill a mouse was but 1 two-millionth of the body weight. Under its influence is noted a gradually increasing weakness, with rapid breathing and lowering of body temperature, followed by death. Its poisonous properties are abolished when it is coagulated by heat, viz., at about 85° C. When applied to the conjunctiva it causes a violent inflammation of this membrane.

Ehrlich showed that animals could, upon repeated administration of abrin, be rendered immune to it, a specific antitoxin being generated. Roemer showed that repeated instillations in a rabbit's eye will similarly produce a marked local immunity, a dose 1000 times stronger than that started with producing no reaction. The

development of this local immunity is very soon followed by general immunity, but, for a time, a dose that excites no reaction in an immunized eye will cause some in its fellow. Calmette and Deléarde made an antiabrinic serum subcutaneous injection of which would prevent its poisonous action, as well as hasten the disappearance of an ophthalmia already induced by abrin. These immunity phenomena have been found to apply to man likewise.

POISONING.—While pounding jequirity seeds one is liable to an attack of conjunctivitis, rhinitis, or bronchitis, and any cuts or scratches on the fingers become swollen, painful, and the center of an erythematous blush. Instances have been reported in which the inflammation caused by instillation of excessive amounts of jequirity extended to the face, neck, and chest. A concentrated infusion has also been known to cause sloughing of the cornea. Careless handling of abrin is extremely dangerous to the eye and the nose. The smallest particle may be fatal in the slightest wound, $\frac{1}{100}$ grain (0.00065 Gm.) of abrin being a lethal dose for a man of 130 pounds weight. The symptoms resulting from internal use or hypodermic injection of abrin are faintness, vertigo and vomiting; cold, clammy surface; dyspnea; a small, frequent, irregular pulse; convulsions, and collapse. Death is said to occur from cardiac paralysis; according to Kobert, from clumping of the red corpuscles. The whole seeds, upon ingestion, are stated by some to cause inflammation of the gastrointestinal tract.

Treatment of Poisoning.—Cardiac stimulants, such as ammonia, ether, camphorated oil, whisky, and digitalis, should be exhibited, and external warmth applied. Amyl nitrite might prove of value. As a specific measure, jequiritol serum should be injected subcutaneously or applied locally, according to indications.

THERAPEUTICS.—In this country jequirity has never been used internally in medicine. At present its use is limited to those obstinate cases of trachoma and pannus, especially the latter, which have resisted other modes of treatment. The essence of its action consists in the replacement of an existing chronic inflammation by another of more violent type, but

of limited duration. Although the drug is said to have been used in Brazil for centuries as a popular remedy for granular cyclitis and pannus, it was de Wecker, of Paris, who, in 1882, revived interest in the remedy by the publication of reports of its successful use in his practice. He recommends its use as follows: Powder 32 jequirity berries and macerate them for twenty-four hours in 1 pint ($\frac{1}{2}$ liter) of cold water; add an equal quantity of hot water, and filter when cool. Sattler advises that the husks of the seeds be removed by means of hot water before the infusion is made. The seeds are then powdered and 6 fluidounces (200 c.c.) of hot water added. After standing for twenty-four hours, the infusion is filtered. Andrews recommends that the husks be rejected, the berries ground and macerated for twelve hours in cold, distilled water, and that then the infusion be filtered, care being taken that the preparation be made in a clean vessel and the maceration be conducted in a cool place. The solution should always be freshly made before use, as it decomposes very quickly.

Any one of the above infusions being selected, some of it is painted on the conjunctival surface of the eyelid with a brush. This is followed by an acute diphtheritic inflammation, lasting three or four days, and attended with fever and pain in the eyes and in the frontal region. This so changes the chronic process present as to permit of a cure. If an excessive action is developed, it may be controlled by hot compresses of a very dilute solution of corrosive sublimate (Hare), or, better, by frequent instillation of jequiritol serum. If the first application gives rise to but slight reaction, it may be repeated after an interval of twenty-four hours, and so on until the desired reaction is obtained.

In jequirity ophthalmia there is generally severe conjunctival chemosis and sometimes considerable edema of the lids. Photophobia, lachrymation, pain, etc., are all present. The acme of reaction is, as a rule, reached in twelve to eighteen hours, and the acute symptoms generally subside in three or four days' time. The infusion of jequirity may

have to be exhibited several times, but it is inadvisable to repeat the instillation until the acute symptoms have subsided. In some cases an interval of a week or ten days must be allowed to elapse.

Two cases of **trachoma** cured by the vigorous application of copper sulphate subsequent to the use of infusion of jequirity. Jequrity properly applied will considerably lessen the time required to cure **granular conjunctivitis**. Use of jequirity after the end of the acute stage in a case of **keratitis** superimposed on an old **trachoma** did not appear to aggravate the keratitic condition in the least, and at the conclusion of treatment the cornea was much improved, very little opacity remaining. The granular condition of the lids also disappeared.

The infusion of jequirity is prepared by the author as follows: Distilled water is boiled and then allowed to cool to 120° F. (49° C.); 12½ fluidrams (50 c.c.) of this are measured out, 1 dram (4 Gm.) of powdered jequirity taken, and the distilled water at this temperature poured on the powdered seeds. This is allowed to stand until cool and the infusion then decanted. The solution should not be filtered, but the slightly opalescent fluid obtained employed for the instillations. If no reaction follows the instillation of 1 drop, it does not follow that the solution is inert. A drop placed in the eye of another person will often induce a vigorous reaction. John Allan (N. Y. Med. Jour., April 12, 1913).

An improved preparation of jequirity now frequently used is that known as *jequiritol*, introduced by Roemer, the eminent German ophthalmologist. It is a sterile liquid containing 50 per cent. of glycerin, and abrin in four different but definite strengths, the preparations being numbered 1 to 4. A single drop of No. 1 is first instilled, then an increasing number of drops, until the characteristic jequirity inflammation is seen. In a few cases No. 1 will produce no reaction, and No. 2 is then used. Upon repeated courses of treatment an immunity develops, so that

even No. 4 will cause no reaction. Whenever too violent a reaction occurs it may be overcome by dropping into the eye at short intervals a few drops of *jequiritol serum*, also a preparation introduced by Roemer.

Jequrity therapy of trachoma does not affect the process in the mucosa, as the granules remain unaltered. Good service is rendered, however, in the **chronic pannus of cicatricial trachoma**, and in **eczematous pannus** and **keratitis**. Old scars on the cornea will frequently yield. E. Hummelsheim (Zeit. f. Augenheilk., Bd. vi, Nu. 5, 1905).

In the presence of purulent conjunctivitis or keratitis, of fresh trachomatous pannus, of recent opacities, or of diseases of the lachrymal apparatus, the use of jequirity or jequiritol is contraindicated.

W. and S.

JOINTS, SURGICAL DISEASES OF.—VARIETIES.—

The affections to which joints are liable are almost all due to inflammation and its results. Their character varies according to the causes which originate them and the extent to which the disease progresses. If the inflammatory action is confined to the lining membrane of the joints, it is designated as a *synovitis*. If, however, it goes farther, and involves the remaining structures in addition, then it is spoken of as an *arthritis*. If pus is a prominent symptom, it may be called a purulent synovitis or arthritis, although when this occurs it is more apt to be regarded as an arthritis. Micro-organisms play an important part in joint inflammations. They are usually of the ordinary pus-producing varieties, such as cause suppuration in ordinary wounds, or sepsis. When this is the case, one speaks of a *septic arthritis*. If the exact source of the infection is known,

then the specific cause of the affection results in its being named according to its origin. Thus one speaks of *rheumatic* or *tuberculous arthritis*; likewise of *gonorrheal* or *syphilitic arthritis*. Sometimes a special name is given, such as *osteoarthritis*, not indicating its origin, but rather the parts affected; also *Charcot's disease* of the joints, so named after him who described it.

Loose bodies in joints occur as the result of injury or disease. When the disease affecting a joint pursues an extreme course, the functions of the joint are destroyed and it may no longer bend. This state of more or less complete fixation is called *ankylosis*, and, after the diseased process has died out and entirely ceased to act, it alone remains and may be the cause of the patient's seeking the surgeon and demanding relief.

For the examination of joints the following are useful guides in testing muscular relaxation: 1. When the patient is lying on his back with his head rested, note the condition of the sternomastoids. If these stand out prominently— which they may very well do without the head being actually lifted, but which means that they are in active contraction—the muscles of the chest and abdomen also are more than likely to be in a state of tension. 2. If the muscles of the lower limbs are relaxed, these will be found to be more or less rotated outwards, this being their position of ease. Unless the patient is coaxed into this position, they will invariably be found held with the feet pointing vertically upwards, which means active contraction of the internal rotators of the femur. 3. The patella should be freely mobile; if it is not, it is a sign of active contraction of quadriceps femoris. 4. If the patient is being examined in prone position, with his head preferably resting on his hands, the relaxation of the glutei is a good

indication of general muscular relaxation. These are particularly sensitive, any interference causing them to contract immediately. General muscular relaxation will be established in this manner in most cases. C. Westman (Pract., Feb., 1921).

SYNOVITIS.

Synovitis is the name given to a simple inflammation, which is supposed to be limited to the synovial membrane. This synovial membrane consists of a fine connective-tissue layer, which lines the joint with the exception of the cartilaginous articular surfaces. In some places it extends into the cracks or crevices between the bones and ligaments; in others it forms more or less marked folds. This is seen in the hip around the ligamentum teres especially, and in the knee around the ligamenta mucosum and alaria. In health the synovial membrane is clear, shiny, thin, and more or less transparent, but when inflamed it becomes dull, dark red in color, and is much swollen and thickened. It is this thickening of the synovial membrane that so often produces the swelling which is seen across the front of the knee-joint at the level of the lower edge of the patella. It is also the main cause of the swelling in diseased joints where no free fluid can be demonstrated. It is extremely vascular and when irritated pours serous fluid into the joint and later even pus, and may serve as the point of origin of loose or floating bodies.

The term synovitis is apt to be incorrectly applied, at times, on account of involvement of other structures of the joint at the same time. The appellation simple synovitis is of considerable service to designate those inflammations which cannot be traced

to specific irritants, such as gout and rheumatism, nor to disease of contiguous structures, such as the bones.

SYMPTOMS.—The symptoms of synovitis are those common to inflammations in general, viz., pain, heat, redness, and swelling, with impairment of function, as well as others due to the peculiarities of the special structure or part involved.

Acute Synovitis.—In acute synovitis the pain may vary from slight to excessively severe. The rapidity with which the effusion may occur can cause intense pain through distention of the joint-capsule. The joint may be red and hot to the touch and very tender. The swelling is due mainly to distention of the joint, both by the increase in size of the synovial fringes and by the increased effusion. Swelling is a most important symptom, and it is much more marked in some cases than in others. In such joints, *e.g.*, the knee, as are not deeply covered by soft parts, the swelling is marked and peculiar in shape, while in those which are not so superficial, as the shoulder and hip, it may be so slight as not to be evident. In these latter joints there may be a slight uniform enlargement which it would be difficult to say was not due to the bruising of the soft parts in case the affection followed an injury. In the knee and ankle, on the contrary, the swelling may be marked, and follow accurately the outlines of the joints. It is influenced in its shape by the overlying structures. Thus, in the knee-joint the swelling of the synovial fringes below the patella causes a protrusion at that level, which is more marked on each side of the *tendo patellæ*. There may be a swelling above the patella or on

each side. The patella is likewise lifted up away from the femur by the effusion, forming the so-called “floating patella,” or, upon pushing the patella downward, it can be felt to strike against the condyles beneath. When the subfemoral bursa communicates with the joint, the swelling often extends quite a distance above the patella. In the ankle-joint the swelling is situated more toward the sides, but is also seen in front. Behind, it is not so marked except on each side of the *tendo Achillis*, which, however, does not play so prominent a part among the symptoms of affections of this joint as do the patella and its tendon in those of the knee. In the case of the elbow, the tendon of the triceps muscle also causes the swelling to be more marked on each side than in the middle. Impairment of function in synovitis is usually marked, and movements are very painful in the acute type of the affection. Not only does pain interfere with the joint's functions, but the effusion into and distention of the joint prevent it from performing them by rendering it looser and less secure, so that weakness is marked and, even if pain be absent, the joint is practically useless.

When an acute synovitis is produced by traumatism only, the effusion is serous, and in a healthy individual it is apt to remain so. After appropriate treatment it will usually disappear, but if at the time of the reception of the injury infection is introduced then pus is likely to form within the joint, and unless radical measures are at once instituted disorganization of the joint and even general infection and death may occur. In other cases the injury serves

as a "*locus minoris resistentiæ*," or place of weakened resistance; the effusion seems to become infected from the blood, and soon may assume a purulent character. In still other cases the synovia seems to be infected from the start, and, while the effusion may be serous at first, it rapidly becomes purulent. In these there may or may not be a history of traumatism. Cases accompanying or following the infectious fevers,—typhoid, pneumonia, and others,—as well as those arising from previously existing pyogenic infections, such as appendicitis, infected wounds, etc., are of this character.

Subacute Synovitis.—In subacute synovitis the symptoms may be less abrupt in their onset and less violent in character. An acute attack may be slow in subsiding or the affection may be mild from the start. The heat, pain, and redness are not so marked as in the acute type, and the anti-phlogistic measures of treatment are not required to be so pronounced.

Chronic Synovitis.—In chronic synovitis the symptoms are characterized by their persistence. The acute pain gives way to a dull, persistent pain, aggravated by use of the joint to such an extent as to forbid it entirely. The redness may disappear and the heat may only slightly or not at all exceed that of the opposite side, but the swelling usually remains and forms a most prominent symptom. The swelling of the synovial membrane of the joint may overshadow the effusion, and then the joint has a boggy or doughy feel which is highly characteristic. The swelling may be very great, owing to the large amount of effusion. Effusion of lymph is most apt to occur in the violent inflamma-

tions of acute attacks. Pus does not often occur in cases of simple synovitis, because infection is lacking. Should this, however, from any cause take place, then pus forms quickly enough. The existence of chronic synovitis implies disuse of the member affected for a considerable time. Marked trophic changes therefore occur. The muscles above and below the joint atrophy, while the joint remains swollen, each of these changes tending to aggravate the appearance of the others, so that together they form a picture of helplessness which is amply borne out by the total inability of the patient to use the joint. If a joint of the lower extremity is affected, the patient either is compelled to refrain from walking or hobbles about only with the greatest difficulty, while if the upper extremity is involved the arm is usually carried in a sling.

Hypertrophic villous synovitis of the knee-joint is frequently mistaken for tuberculosis and treated as such. The condition results from an infective process elsewhere in the body. It begins as an acute synovitis which becomes chronic with or without enlargement of the joint. A late picture of the disease shows marked enlargement of the joint with large masses protruding from either side of the patella and the quadriceps tendon and a rather less prominent patella. There is present an overgrowth of the synovial membrane and synovial fringe. P. H. Kreuscher (Surg. Clin., Chicago, i, 1291, 1917).

ETIOLOGY.—The principal cause of simple synovitis is injury. The joint may have been knocked, bruised, or strained. Exposure to cold and wet may be followed by a simple inflammation of a joint, with no other evidences of rheumatic or other con-

stitutional affection. Sometimes the disease seems to appear without immediate cause, but in these cases the affection has probably been the result of an injury so slight as not to have attracted the attention of the patient at the time or else have been since forgotten.

If infection is introduced either at the time of the injury or subsequently through the blood-stream, the effusion rapidly becomes purulent. Cases arising without any history of previous injury are almost certain to have an infectious origin. They may be metastatic in character and may also be due to syphilis, gonorrhea, etc., although the effusion present in a synovitis due to the last-named cause is more apt to be of a plastic than of a fluid character.

Synovitis due to sporotrichosis may resemble acute synovitis of pyogenic origin, subacute gonococcic synovitis, and chronic tuberculous synovitis. The diagnosis is easily made by culture, agglutination, or complement fixation methods, and the readiness with which the foci disappear under potassium iodide. H. Gougerot and G. Lévi-Fränkell (Revue de chir., Nov., 1912).

PATHOLOGY.—The affection consists of an inflammation of the synovial membrane of the joint with an outpouring of synovia, serum, lymph, or pus into the joint-cavity.

The joint-surfaces may lose to some extent their smooth, glistening character, while the synovial fringes become injected, begin to proliferate, and tend to encroach on the interior of the joint and the surrounding cartilage. The natural secretion of the joint may become increased; it may contain lymph or even pus. In a quickly developing synovitis the se-

cretion may be thinner than normal, owing to the sudden outpouring of serum. Not infrequently the injury which has produced the synovitis may likewise have caused some bleeding into the joint, in which case the contained fluid will be blood-stained or consist even of blood-clots.

While the first effusion may be liquid in character, it may speedily disappear and leave a fibrous effusion, with enlargement of the synovial fringes. The latter gradually solidify and form adhesions, which tend to bind the bones together, producing a fibrous form of ankylosis that limits movements and seriously cripples the joint.

TREATMENT.—The treatment of synovitis varies with its acuteness. In a sharp attack constitutional disturbance may be marked, the pain is severe and fever high, and the patient is tortured by suffering and deprived of sleep. The usual antiphlogistic treatment is here of value; a free **saline purge** is of service, aided by **acetanilide** or **acetphenetidin**. To produce sleep **sulphonal**, **trional**, or **veronal** may suffice, or if the pain is more severe, **Dover's powder** or other opiate may be given in sufficient quantities to procure rest.

Local treatment is all-important. Complete **rest** of the part is essential. If the knee is affected, **sand bags** may be placed on each side, or a **paste-board splint** fastened on the back of the leg by adhesive straps above and below the joint, leaving the latter exposed for treatment. A cradle should be used to prevent the bedclothes from touching the part.

Bleeding has gone somewhat out of fashion, but a few Swedish **leeches** or the application of a few **wet cups** will

give quicker results than almost any other means. The cases in which one will be inclined to use those means are, however, few. Ordinarily an **ice-cap** may be applied; but in other cases **hot applications**, such as woolen cloths wrung out of hot water, or **hot-salt bags**, or a **hop poultice** made by heating hops in a pan, moistening them with vinegar and inclosing them in a bag, or even the use of the ordinary rubber hot-water bottle, may be used. Personally I am partial to the use of the **splint** and **ice-cap**.

When the pain and tenderness have somewhat subsided, light **massage** may be employed. Massage is not used to anything like the extent it deserves. Employed daily, very lightly at first and afterward more firmly, I am convinced of its great efficacy.

Primarily, acute synovitis is caused by traumatism, but it is often secondary to rheumatism, gout, gonorrhea, pyemia, and the exanthemata. In simple synovitis all that may be required is **immobilization**, a well-applied **splint**, and an **ice-bag** for a few days. When the extreme pain and swelling have subsided, **passive motion** should be practised daily. If the swelling does not subside at the end of a week one may **aspirate**. **Pressure** is of great value in favoring the absorption of the exudate, *e.g.*, by a roller bandage evenly applied, strapping with adhesive plaster, or a rubber bandage.

Hot local applications are sometimes more agreeable to the patient than cold, and give as good results. Should the condition tend to become chronic, counterirritation with **iodine**, **blister**, and **liniments** is indicated. In rheumatic cases one should give **sodium salicylate** in full doses. **Dry heat** is very valuable: wrap the limb in flannel and expose it in an oven to the temperature of 300° F. to 400° F. half an hour once a day. Palmerlee (N. Y. Med. Jour., Feb. 23, 1907).

In non-infected synovitis rest is secured by a **splint** or **sling** in the upper extremity and by confinement to bed and splints in the lower extremity. **Elevation** is also of benefit in the case of the lower extremity. The elbow should be fixed at a little less than a right angle, the knee slightly flexed, and the ankle fixed with the foot at a right angle to the leg.

Dry heat should be used once a day, depending on the severity of the case, the affected joint being well wrapped in Turkish toweling. Afterward the limb is rubbed dry, bandaged, and the splint replaced.

An even, **elastic pressure** should be maintained between **hot-air treatments** by surrounding the joint with a thick layer of cotton batting, over which a roller bandage is snugly applied. If after three days of this treatment the swelling remains stationary or increases, the joint should be **aspirated**. No great amount of fluid need be withdrawn, as the removal of a few drams is often followed by rapid absorption of the remainder. After aspiration the treatment should be continued. **Passive movement** and **massage** should be employed as soon as the joint regains its normal size, and an elastic bandage should be worn for several weeks after the patient is allowed full use of the joint. G. J. Ellis (N. Y. Med. Jour., Feb. 23, 1907).

Obstinate cases of subacute and chronic synovitis are best treated by absolute **rest**, as far as any use of the joint is concerned. The disease is often kept alive and troublesome because the patient persists in using the joint to the extent that the pain will allow him to. **Massage** is not incompatible with rest, but violent passive motion is. Therefore the joint may be rubbed to keep up its circulation and nutrition, but not irritated by bending. **Hot-air baths** are likewise of the greatest service to remove

stiffness. Firm **strapping with adhesive plaster** is of marked value and is an effective means of hastening absorption of the effusion.

In recurring serous effusions in joints, especially the knee, the cause is often a congenital laxity of the ligaments, exposing the synovial membrane to unusual irritation during prolonged use of the joint. The treatment should not be immobilization, which aggravates the condition through disuse of the muscles supporting the joint, but **massage** of these muscles (*e.g.*, those of the thigh, in the case of the knee) twice daily. This will lead to a sufficient development of the muscles to make up for the laxity of the ligaments. In very pronounced cases articulated supporting apparatus may in addition be required. Gangolphe (*Lyon méd.*, June 23, 1912).

The question of **tapping** a distended joint to remove the effusion is an important one. I do not believe it correct to say that the procedure is without danger. On the contrary, it should be done in the most careful manner; otherwise, the joint is apt to be infected and a serous effusion changed to a purulent one, with a possible disorganization of the joint. Properly to tap a joint, the first essential is to get a sharp trocar the cannula of which is so closely fitted as to allow it to pass through a piece of leather without catching. Very few trocars stand this test, and all others are positively dangerous. It should be thoroughly disinfected—preferably by boiling. The part should be likewise thoroughly cleansed by scrubbing and antiseptics, or by painting with iodine, as for any other serious surgical operation. The surgeon's hands require the same careful treatment. After tapping, the opening should preferably be sealed with

collodion and gauze or cotton. If a bandage is applied with a dressing, the greatest care should be taken that it be so large and so firmly secured that it can by no possibility become displaced and the puncture exposed. Tapping done in this manner is of great service and not accompanied by much risk. I have never had the slightest bad effects from it, but make it a positive rule to observe the greatest precautions against introducing infection.

Effusion into a joint is the result of abnormal nervous excitability of the synovial membrane. **Injection of phenol** or tincture of **iodine** overcomes this, but the effect is much enhanced by preceding the phenol injection with one of **salt solution**, to wash away secretions from the surface of the membrane, as well as by completely expelling the blood from the part. This lowers the amount of fluid in the tissues, and they take up the injection better. Hildebrand (*Archiv f. klin. Chir.*, Bd. lxxxi, part 2, 1907).

The writer deplors that so many men with hydrarthrosis of the knee are allowed to go for months before the knee is punctured. When the joint effusion is withdrawn promptly, smooth recovery is the rule in 30 or 35 days, but he has encountered many cases in which this was neglected or postponed, and the men after 8, 11 or more months are still incapacitated by their knee lesion. Laubie (*Jour. de Méd. de Bordeaux*, June, 1918).

If desired, the joint may be washed out by injections made through the cannula. **Salt solution** or weak antiseptics, such as **bichloride of mercury**, 1:5000, or **phenol**, 1 per cent., may be used; they are not to be allowed to remain in the joint. The injection of **formaldehyde** in a 2 per cent. solution in glycerin, as recommended by Murphy, is efficient, but so painful as

at times to necessitate the administration of an anesthetic.

In a case of right gonarthrotomy for purulent fibrinous synovitis in a woman, 72 years of age, who had suffered 4 months from severe inflammation with slow synovial involvement in the right knee, the writer made a total **cuneiform resection** of the knee. Intervention was limited to the synovial cavity, emptying purulent fluid from all recesses and making a careful toilet of the wound. The patient made an uneventful recovery in spite of her advanced years. N. Federici (*Gazz. d. Osped.*, xxxviii, 571, 1917).

Stiffness following synovitis, where pain is not marked, may be treated by persistent, but not violent, **passive motion** and **massage**. If this is not successful, free movement of the joint under an anesthetic may be tried, followed for a short time by complete **rest** and the **ice-cap** until reaction is past, when **passive movements** and **massage**, the use of the **hot-air bath**, the application, perhaps, of **iodine** to the joint, or compression by a **rubber bandage** may be tried. Chronic joint affections will tax the skill of the most experienced, and the surgeon must call on his ingenuity to devise means to achieve success.

Report of cases of supposed neuralgia in joints, sometimes with recurring effusion, which proved to be the result of a minute disease focus in the adjoining long bone, and were cured by the wearing of a **splint** or by **curetting**. Garré (*Münch. med. Woch.*, Nov. 22, 1910).

In the treatment of gonorrheal synovitis removal of the exciting cause, the urethritis, is necessary. The bowels should be kept freely open, **syrup of iodide** should be given, and an easily assimilated **diet** ordered. Injections of **antigonococcic vaccine**, 200 million bacteria, are useful. **Rest** in bed, **immobilization** of

the joint, and rubbing with **blue ointment** are, in addition, necessary. After the acute symptoms subside, **fly blisters** and **Bier's hyperemia** should be employed. If fluid forms, the joint should be **opened** and irrigated with **hot normal salt solution**, followed by an injection of **iodoform emulsion**. **Massage** and **passive motion** should be begun early. If ankylosis occurs it may be necessary to break up adhesions under anesthesia. Blumenfeld (*Med. Rev. of Rev.*, Oct., 1912).

Yellow vaselin injections used with success in simple dry synovitis or senile joint affections in which the synovial membrane has lost its secreting power. They will also prevent ankylosis after resection of a tuberculous joint process, if all the diseased tissue can be removed and there is no mixed infection requiring drainage. Where fluid is present in a joint, vaselin injection is superfluous and may do harm. The author employs a collapsible tube of vaselin and boils the whole for fifteen minutes before the injection. Embolism is prevented by using a blunt-pointed cannula, being sure that no blood escapes from it, and that the point moves freely in the joint, before the cannula is screwed to the rubber tube connected with the vaselin. The amount injected is about 20 or 25 c.c. (320 to 400 minims) for the hip-joint; not over 10, 12, or 15 c.c. (160, 180, or 240 minims) for the knee; 15 c.c. (240 minims) for the shoulder. Rosing (*Hospitals-tidende*, July 30, 1913).

ARTHRITIS.

Arthritis is an inflammation of the entire joint, instead of only its synovial membrane, as in synovitis. Clinically the difference is mainly one of degree. An inflammation that begins in the synovial membrane may involve the capsule, the cartilages, and eventually the bones. It is a more serious affection, more severe in

its symptoms, more exacting in its treatment, and more serious in its prognosis. It may be started by an injury, by exposure, by infection either direct or through extension from neighboring diseased structures, or by a constitutional cause.

The cervical vertebræ are frequent points of attack for *scarlet fever arthritis*. Not only rheumatoid pains arise in this region, but genuine arthritis as well. There is also some swelling, sometimes severe wryneck with violent pain when any attempt is made to move the head. In some cases ankylosis results which may require orthopedic treatment. Mayet and Laval (Bull. méd., Mar. 13, 1920).

Among the numerous causes of arthritis recorded have been diseased teeth and tonsils, fecal stases and other focal infections; also the various acute fevers, suppuration of the umbilical cord in infants, leucorrhea, puerperal discharges of various kinds from the mother, bronchiectasis, whooping-cough, appendicitis, dysentery, and other intestinal troubles, and cutaneous infection, such as ulcers, wounds, and vaccinations.

Billings and his followers point to the careful work of Rosenow and others on the bacteriology of arthritis and to the numerous cases of improvement and cure of arthritis following removal of diseased teeth and tonsils. They believe that this proves the accuracy of their contention that a focus of infection exists in the head in many of these cases. Others either reject the theory or accept it in a modified form. There is, however, undoubted improvement in numerous cases of arthritis following the removal of an abscessed tooth or a diseased tonsil or when a case of active pyorrhea has received proper treatment. On the contrary, many such cases are given similar careful treatment without affecting the

progress of the joint condition in the slightest degree.

One reason for the failure to obtain successful results in arthritis by treatment of dental and tonsillar disease is that the cases have been selected without knowledge of the exact pathological condition present in the organ in question. Many apical abscesses in which nature has effected a cure by walling off the disease have been treated by extraction of teeth. In such a case it may have caused dissemination of the infection to other parts of the body, with dire results. In the same way the crypts in certain areas of a tonsil may overcome an existing infection. These crypts are often perfectly harmless. Another reason for failure in arthritic cases is due to the fact that the focus of infection lies in some other part of the body. It may be discovered by further careful search in the lungs, heart, kidneys, genito-urinary or gastrointestinal tracts, ductless glands, the nervous system, and elsewhere. A certain number of cases are due to syphilis and to tuberculosis. Unfortunately in many cases it is never brought to light. Roland Hammond (Amer. Jour. Med. Sci., Oct., 1918).

SYMPTOMS.—In arthritis the symptoms peculiar to synovitis are more marked; the fever is high, if the disease be acute; the constitutional disturbance is severe; the swelling is marked; edema may be present, and the joint tender, particularly on its surface, though also deeper in; the joint is flexed and rigid; atrophy of the muscles is rapid; if the joint is moved, grating may be heard, owing to destruction of the cartilage, and, as the disease advances, sinuses may form, bone may exfoliate, and even dislocations occur, with total disorganization of the joint. Sometimes the disease necessitates amputation or causes death. Often its course is very rapid. Infants and older chil-

dren are particularly liable to a form caused by extension of inflammation from the adjacent epiphysis, and this is productive of the most serious results.

Not only are the joints more susceptible to inflammation in children than adults, as stated by La F  tra, but the tissues about the joints are more susceptible in infants than in older children. Shortly after birth the infections oftenest met with are those due to sepsis; later, though during the first few months, those due to the gonococcus. Both these infections are apt to be multiple. Between the first and fifth year the infective agent may be the streptococcus, staphylococcus, pneumococcus, typhoid bacillus, influenza bacillus, and occasionally the colon bacillus. Joint disease in children over 5 is usually either tuberculous or rheumatic. There also occur in infants and young children infections of bone and of cellular tissues adjacent to the joints, often giving rise to swellings and other signs very similar to those of joint involvement. Osteomyelitis and periostitis, epiphysitis, and deep cellulitis often occur, and may extend into the joint capsule. Absolute determination of the form of infection can only be made by study of fluid from the inflammatory focus, but a probable diagnosis can usually be made from the history and general physical examination. EDITORS.

One may meet, especially in the autumn, with cases of joint involvement, generally with a history of sprain or strain, in which the articulation affected is enlarged, swollen, tense, or with marked effusion, but not red, painful especially on motion, and with slight increase of local heat. The urine is hyperacid, with brick-dust deposit, and there exist depression, acid dyspepsia, occasionally pruritus, and even eczema. The pain simulates intercostal neuralgia, gall-stone, podalgia, or severe pain in the fibrous tissue about the os calcis. The cause of the whole disturbance is eating tomatoes. Johnson (Annals of Surg., July, 1912).

From an exhaustive study of the subject, which included a number of

experiments, the writer concludes that it is fairly certain that all the various forms of polyarthritis may be caused by infections. The pathological lesions correspond exactly with those of known infections and the clinical phenomena can all be ascribed to differences in the location and virulence of the bacteria, the mechanical conditions and the presence or absence of central or peripheral nerve involvement. The classification of the so-called arthritis deformans into definite infections and problematical metabolic disturbances he therefore considers no longer necessary so far as the joint conditions are concerned. P. W. Nathan (Jour. Med. Research, xxxvi, 187, 1917).

An epidemic of 321 cases of meningococcus infection indicated that there were 3 forms. *Type A*: an acute polyarthritis, often with a number of other symptoms of onset; it rarely appears later than the third day of the disease. It attends a severe infection and is usually a harbinger of a stormy course. Almost all have profuse hemorrhagic rashes coincident with the polyarthritis; often the arthritis is as transitory as the rash. These early joint symptoms seem due to hemorrhage into the articular and periarticular structures, especially the synovial membrane and identical with the hemorrhagic lesions of the skin and serous membranes. It resembles acute rheumatic polyarthritis. In *Type B* the onset is about the fifth day. One joint is usually affected, generally the knee, occasionally the ankle, hip, shoulder, wrist or elbow. Effusion is a prominent feature, so that aspiration of the synovial capsule is suggested in many cases. Swelling is great, but redness, pain, tenderness and limitation of motion are surprisingly slight. In no other acute arthritis is there this striking disproportion between the swelling and the other inflammatory signs. The duration of the process is usually from one to four weeks, recovery being gradual, but complete. *Type C* is the familiar serum arthritis. Her-

rick and Parkhurst (Amer. Jour. Med. Sci., Oct., 1919).

TREATMENT.—The treatment of arthritis in its mild form is practically that of synovitis, which has already been detailed at length. It is in the highest degree desirable that the serious character of the affection be recognized as soon as possible, in order that more rigid precautions may be taken than would be considered necessary in synovitis. It is more justifiable to resort to severe measures. The consequences of an arthritis are almost sure to be some limitation of the usefulness of the joint; not seldom total stiffness ensues, or the suppuration may be so marked as to demand resection or amputation to save life. If the disease is acute, absolute **rest** in bed with the limb on a posterior **splint** (if the knee be affected) is to be enforced, together with the application of **leeches**, **wet cups**, or **ice**.

The next step is to remove the cause of the infection which in turn gives rise to the arthritis, whichever it be dental, tonsillar, etc., among those enumerated. In many instances, elimination of the primary cause suffices to insure recovery.

The writer found improvement in 50 per cent. of the cases of chronic arthritis treated at the Stanford University clinics by the **removal of foci of infection**. In 21 cases, 76.2 per cent. showed no improvement; 4.8 per cent. were worse. The most striking results were obtained where the focus was situated in the genito-urinary tract, but long continued faithful treatment was necessary. Very rapid recovery with very few treatments was obtained when the teeth were the seat of infection. Removal of the tonsils in several cases was followed in a few days by loss of pain, and later by return of func-

tion to the injured joint. H. S. Chapman (Annals of Surg., May, 1920).

Sometimes adhesive-plaster **extension** with weights is required. The amount of weight used is to be gauged by the patient's feelings. In the hip-joint particularly is extension necessary. In the ankle and shoulder plaster-of-Paris fixation-**splints** are of service, because in those joints motion is most apt to be marked.

Distention of the joint is to be relieved by **tapping** with or without the **injection of normal saline** or **weak antiseptic solutions**. Some authors recommend the **salicylates** but the large doses should be avoided owing to their evil influence on the heart.

Good results from **extension**, according to the **Bardenheuer** adhesive plaster **technique**, in the treatment of gonorrheal arthritis, especially in cases with marked doughy swelling and extreme tenderness, likewise in some forms of subacute and chronic rheumatic arthritis. The extension was employed in 15 cases of arthritis unamenable to other methods, including 10 of the knee-joint, 4 of the hand, and 1 of the elbow. In 10 cases the results were excellent and in 3 satisfactory, while in 2 **Bier's hyperemia** proved superior. H. Hochhaus (Therap. der Gegenw., Hft. 1, 1912).

The writer found it possible to relieve patients of practically all symptoms of diffuse arthritis by a large **curtailment of carbohydrate**, coincidentally with the **ingestion of fat** in such increased amounts as to make up or exceed this caloric deficit. When the protein intake has been kept approximately constant some such patients actually gain weight while convalescing. Pemberton (Arch. Intern. Med., Apr. 15, 1920).

Cartilage in a healthy state is not sensitive, but when a joint becomes inflamed any pressure of the joint-surfaces together is productive of

great pain and increases muscular spasm. Should the inflammation continue increasing, the joint should be **tapped** as described under the treatment of synovitis; instead, however, of merely allowing the liquid joint-contents to escape, the whole joint should be washed out. For this purpose sterilized **salt solution**, a saturated **solution of boric acid** which has been boiled, or a weak **bichloride of mercury solution**, 1:3000 or 1:5000, may be used.

Sixteen cases of joint infection treated by **aspiration** and **injections of 2 per cent. formalin in glycerin**, together with **extension** by weight and pulley. Best results obtained in acute and subacute cases; tuberculous synovitis gave excellent results. To each ounce of glycerin 10 drops of formaldehyde solution are added. The mixture should be kept in a sterile container and not over 24 hours old when used. Before injection of a joint the extension apparatus is adjusted, the joint painted with two coats of tincture of **iodine**, and, with the patient anesthetized, the fluid aspirated. The **formalin-glycerin** is then injected until the joint is completely filled—in the knee about $\frac{1}{2}$ ounce (15 c.c.). Equal distribution of the solution may be secured by motion and massage. A **morphine** injection is given. On the second day a diffuse hyperemia occurs, which may be controlled by an **ice-bag**. On the fourth day the swelling recedes. The extension apparatus may now be removed daily and the joint **massaged**. The interval between injections is usually ten to fourteen days; 2 injections often suffice, though 5 may be needed. After the last injection a tuberculous case is allowed to walk on crutches four to six months, wearing a long three-fifths $\frac{3}{5}$ circular cast and receiving **tuberculin** injections of 5 to 10 mg. ($\frac{1}{2}$ to $\frac{1}{8}$ grain) once a week. Non-traumatic synovitis of the knee

was cured by 2 injections. One case of synovitis of the shoulder and one of beginning arthritis deformans were not improved. C. L. Pooley (North-west Med., March, 1911).

If the inflammation increases and pus forms, the joint will have to be drained. **Drainage** of the various joints is not apt to be a very satisfactory procedure. This is because there are no empty spaces for the drainage-tube to lie in. The bones touch each other and the interspaces are filled with the synovial fringes, while all are closely embraced by the capsular ligament. The knee-joint is the one most commonly treated by drainage. One of the best methods is to pass a tube into the joint just below the patella and to the inner side of the median line. It is then carried between the condyles and made to emerge posteriorly on the outer side of the popliteal vessels. Another way is to insert one on each side of the patella and another well back in the joint from side to side. The joint, however, is such an intricate one that good drainage is very difficult, and if the disease increases, something further may have to be done. The choice will lay between **amputation** or **resection** and some form of **arthrotomy**. The recuperative powers of childhood are so great that conservatism is far more judicious than is the case in youths and adults. In young children partial procedures are often preferable to more radical ones. Resections in them give extremely bad results on account of the interference caused with the growth of the limb. The disability and deformity, which at the time of the operation may have been comparatively slight, can become so severe as subsequently to

make amputation necessary. Amputations are resorted to only as a means of saving life in children, but in adults the probability of a good result after very extensive bony disease is so slight that amputation is justifiable where in a child resection would suffice. In adults, also, resection of a joint is resorted to earlier than in children. If a marked purulent arthritis once becomes established in an adult, **resection** is often demanded, and it is not advisable to defer operating until extensive disease of the bones is present. After pus once forms in the joint of an adult the joint is very apt to remain stiff even if cure occurs; the result after a resection is no worse, and the course of the disease is much shortened. One does not have to fear subsequent deformity due to the disparity in growth of the two limbs. In very young children formal resections may give way to atypical operations, in which the disease foci are gouged away and even some cavities deliberately cleansed out, packed with iodoform wax or gauze, and left to granulate. Even these partial operations should not be undertaken until the disease is marked.

In infection of a joint by staphylococcus, immediate **free incision** is advisable, followed by **irrigation** with large quantities of **normal salt solution** and the establishment of perfect **drainage**. All this must be done under the strictest antiseptic precautions, in spite of the fact that inflammation is already present, to prevent engrafting a streptococcus infection upon the less virulent type already present. Drainage may usually be discontinued about the third to sixth day unless fever and great swelling continue. Where there is extensive injury to the joint it is well at the first treatment to fill the joint with **phenol-camphor solution**:

Phenol and camphor, of each, 2; alcoholene, sterilized, 1. Lanphear (Am. Jour. Clin. Med., March, 1909).

The writer reports 5 cases of suppurative arthritis with diplococcic, staphylococcic, or streptococcic joint infections, some with and some without intra-articular fracture, in which simple **arthrotomy** and **immediate active mobilization** was followed by good results. Arthrotomy is far superior to primary or secondary resection in suppurative arthritis. Willem's (Presse méd., Mar. 28, 1918).

Failure of general health is the best indication for operative procedures. In children up to the age of about 5 years even free suppuration of a joint may often be cured without severe operations. A great deal depends on the mechanical ability of the surgeon to handle these cases conservatively.

Arthrectomy, or **eration**, is the scraping or curetting of a joint with the removal of the synovial membranes in so far as is possible. Its results have not been so brilliant as was anticipated. The procedure will probably be followed by stiffness, and the likelihood of cure is not so great as if a formal resection were done. It is most applicable in children of an age unsuitable for resection. In such patients, accompanied by a free use of the curette for the removal of disease foci in the bones, it is the operation of choice. As one approaches adult age so does its desirability lessen.

Treatment of Chronic Cases.—Arthritis not infrequently pursues an extremely chronic course. Its treatment must vary according to the diathesis present. Thus, syphilis, rheumatism, or other constitutional affection demands the constitutional remedies appropriate to it, in addition to the local

treatment. Many arthritic cases are kept in a chronic condition by the inability or indisposition of the patient to keep the joint sufficiently long at rest for a cure to be effected. I have frequently seen joints improve after other methods had been tried when absolute **rest** in bed was enjoined. This rest should be insisted on until all evidences of activity of the disease have ceased. By rest is meant that the joint is so fixed by some splint or dressing that no movement of it is possible. Many physicians do not appreciate the importance of **complete fixation**, and apply dressings that are inefficient and fail to control the disease. In affections of the knee-joint, for instance, it is not doing too much to bandage the limb firmly to a well-padded posterior splint that reaches from the heel below to the gluteofemoral fold above; a sand bag should then be placed on each side of the limb and the whole held together by 2 or 3 transverse pieces of bandage. **Splints** applied with the intention of securing rest of a part are often made too short, both in the case of the upper and of the lower extremity. It is not infrequently necessary to immobilize the joints both below and above the one that is affected.

In the treatment of gonorrheal arthritis nothing gives better results than placing the patient in bed, giving a urinary antiseptic, usually **hexamethylenamine**; **aspirating the pus** from the worst joints, **splinting** and **bandaging** them, and giving an eighth strain **gonococcus vaccine** hypodermically (not into the muscles). W. Baetz (Jour. Amer. Med. Assoc., April 5, 1913).

Report of 20 cases of chronic arthritis of various types, all tentatively diagnosed as due to streptococcal in-

fection, and treated with **streptococcic vaccines**. The vaccines used were of streptococci obtained either from the mouth, urine or feces. Jones (Brit. Med. Jour., May 17, 1913).

The writer states that primary and secondary **proteose preparations** stimulate antibody production or mobilization for specific organisms in gonococcal arthritis in a manner not to be distinguished from that produced by the injection of the specific organisms themselves. The first injection usually causes the greatest clinical benefit. Culver (Jour. Laborat. and Clin. Med., Oct., 1917).

The writer describes improvement attained in 60 per cent. of chronic arthritis cases treated by injections of his **non-specific protein** preparation made from millet and alfalfa seeds. This is used in a 2 per cent. solution and the dose starts with 10 to 12 minims (0.6 to 0.75 c.c.) and is given in increasing doses 3 times a week from 4 to 10 months. S. P. Beebe (Med. Record, July 27, 1918).

The joints of the lower extremities are the ones most often affected, but those of the upper are likewise attacked. When the wrist is involved the hand and forearm up to the elbow may be enveloped in a **plaster-of-Paris** or preferably a **silicate-of-soda bandage**. Another convenient way of fixing the wrist is by means of leather. A piece of harness or not too heavy sole-leather is obtained, and two pieces cut of a size suitable to reach from near the elbow to the metacarpophalangeal joint and each halfway around the arm. They are then to be soaked in warm—not hot—water and applied to the arm; with a penknife a space is cut for the thumb and the splints shaped to fit the hand and forearm. The edges may be shaved thin so as to allow of overlapping. With a bandage the two pieces of leather are fastened

firmly on and allowed to remain until the next day. They will then be found to be hard, when they can be removed, lined by pasting chamois-skin on the inside, varnished with shellac if desired, and fitted either with straps or eyelet holes for lacing. Over the affected joint a piece of lint anointed with **belladonna** and **mercury** or **ichthyol ointment** may be spread, or it may be painted with **iodine** or treated in any way desired.

The use of local **hot-air baths** is very desirable in arthritis arising from traumatic or rheumatic causes, but not in tuberculous ones. This is likewise true of **electricity** and **massage**. The hot-air baths should be carefully watched to see if their effect is suitable to the particular case, for not infrequently they aggravate instead of alleviating the trouble.

When any one of the three large joints of the upper extremity is affected the hand should be carried in a **sling**. When the elbow or shoulder is to be treated silicate of soda probably makes the best **splint** material. It would be far more popular than it is if the method of its use were better understood. The secret of success is first in having the bandages thoroughly impregnated with the silicate, and, secondly, in not applying too much silicate while making the splint. If gauze or scrim or crinoline be used, it is easy enough to have it thoroughly soaked with silicate, but with cotton bandages a certain amount of silicate should be placed in a basin and the bandage allowed to pass through it as it is wound by hand. A convenient machine for the preparation of these bandages is one I have been using for years. It consists of a V-shaped box into which the sili-

cate is poured. The bandage goes over the edge of the box down under a rod at the bottom and up to be wound around a small handle, or winch. In applying these bandages the part is first covered in the same manner as for plaster of Paris. All surplus silicate is squeezed from a bandage, and it is then applied. After a couple of layers, strips of tin are laid on and covered by a couple more layers of bandage. These tin strips should always be used in dressings of any size, as they prevent the bandage from becoming wrinkled, keep it in shape until properly hardened, and also add somewhat to the strength of the apparatus. Additional silicate is *not* to be smeared on over the various layers of bandage. The hand should be moistened with warm water and the bandage smoothed therewith. Made in this manner, the bandage will take about twenty-four hours to dry, and will get as hard as a stone and yet be extremely light.

It may be made removable by cutting down with a knife and inserting hooks or eyelets. If hooks are desired, the large size may be bought at any dry goods store and sewed to the folded edge of a strip of unbleached muslin. This is then pasted along the cut edges of the bandage with additional silicate and left for another twenty-four hours to dry. The bandage if applied for disease of the elbow should be carried well up toward the shoulder and down toward the wrist. If this is not done too much motion is allowed at the joint. When the shoulder is affected the arm is to be confined by the dressing to the body, to prevent its swinging.

In the treatment of chronic joint diseases **orthopedic apparatus** can

often be used to advantage. Thus, in disease of the elbow-joint a useful form is composed of two side-irons with a joint opposite the elbow which is capable of being so regulated as to allow a little or no motion, as desired. The two side-irons are fastened to the arm by two leather sockets, one lacing around the arm above and the other below the elbow.

Affections of the hip-joint are usually treated by adhesive-plaster **extension**, from 5 to 15 pounds being used; the limb is steadied either by sand bags on each side or by means of a long, lateral splint.

In walking cases some form of the old **Davis or Taylor** traction splint may be used. The same object is accomplished by the patient's wearing a high shoe on the **healthy limb** and using **crutches**. The affected limb is allowed to hang. To steady it a **plaster-of-Paris or silicate-of-soda or other dressing** is applied around the pelvis and thigh, down to the knee. The long posterior splint of **Thomas** is also of service. For the knee one may use an elastic knee-cap or a light plaster-of-Paris **splint** or one made of leather or silicate of soda; even pasteboard is suitable. Of whatever material the splint be made, it should go high up toward the hip and low down toward the ankle; otherwise, too much motion will be allowed. Thomas has also devised a serviceable apparatus to be used in these cases. It is composed of two **side-irons** in the form of the letter U. The two upper ends are joined by a padded iron ring and the opposite extremity projects beyond the foot. The patient puts the leg through the ring and practically sits down on it, allowing the leg to hang between the side-

irons. A bandage confines the apparatus to the limb. Other forms of apparatus are also of service. Thus, one can be made with two side-irons which are jointed opposite the knee-joint. At least one of these side-irons goes down to the foot and is fastened to a steel sole-plate. If this is not done, it will be found almost impossible to keep the apparatus from sliding down. The amount of motion to be allowed is regulated by altering certain stops at the knee-joint. Many of these knee cases can be allowed a certain amount of motion with benefit, because it is only when the motion is excessive or takes place in some unusual direction—as twisting—that it is harmful.

For the **ankle, silicate-of-soda, plaster-of-Paris, or leather supports** are needed. In light cases the elastic-webbing bandage or Martin's rubber bandage gives considerable support. If it is desired to keep the joint quiet, the dressing should extend well out toward the toes and well up toward the knee. For more permanent use a steel sole-plate may be inserted in the shoe, and from it two side-irons go up the leg. There need be no ankle-joint, as the patient can walk quite well, even with the ankle stiff. An apparatus can be constructed on somewhat similar lines to go inside the shoe, and thus may be worn with different shoes.

OSTEOARTHRITIS, OR ARTHRITIS DEFORMANS.

In recent years the many varied affections included under the names of rheumatism, rheumatic gout, rheumatoid arthritis, osteoarthritis, arthritis deformans, etc., have been more closely studied and their classification changed. An attempt has

been made to arrange them according to their etiology, but as that is to a considerable extent unknown, the subject is still in a transitory state. It has been generally recognized, however, that there are two great divisions of the ordinary joint disease, exclusive of those caused by traumatism and trophic disturbances due to derangement of the nervous system, as locomotor ataxia, syringomyelia, and the like. These two divisions are the *infectious* and *metabolic*. The infectious joint diseases are those caused by infections either arising primarily in the joint or carried to the joint from some focus of infection in another portion of the body. The disease known as acute articular rheumatism, although often confining its manifestations solely to the joints, is now regarded as being without doubt a germ disease, the infection gaining access to the body possibly through the nasopharynx, tonsils, etc. The other joint diseases due to infection are caused by either ordinary pyogenic organisms or the germs of specific diseases, as syphilis, gonorrhea, tuberculosis, and nearly all of the acute infectious fevers, including typhoid fever, pneumonia, scarlet fever, measles, and others. The infectious etiology of the cases has been proved beyond doubt, but there still remain numerous cases in which disturbances of nutrition and metabolism are marked causative factors. These have been previously grouped under the terms rheumatic arthritis, rheumatoid arthritis, osteoarthritis, etc. In this large group occur cases in which infection appears to play an important rôle, while in others it appears as though a disturbed metabolism were the underlying cause. So

far one has been unable to draw a sharp line between the infectious and metabolic cases. It is above all in the chronic cases that this difficulty exists. This class of cases has for the sake of convenience been aggregated under the term osteoarthritis, and subdivided clinically into two groups: one in which atrophy is a distinguishing feature and therefore called the atrophic type, and another in which hypertrophy is evident and hence called the hypertrophic type.

DIFFERENTIAL TABLE.

ARTHRITIS DEFORMANS.	RHEUMATIC ARTHRITIS.
1. Nervous disease due to debilitating causes.	1. Follows rheumatism always.
2. Its last stage is osteoarthritis.	2. Has no connection with osteoarthritis.
3. Symptoms constitutional as well as local.	3. More confined to joints.
4. Joints most used are the first affected, smaller joints first, running centripetally. Temporomaxillary joints often affected. Symmetry of affected joints more noticeable.	4. Large joints often first affected, running centrifugally, and chiefly joints affected that were attacked in previous acute rheumatism. Temporomaxillary joints never affected. Not so often symmetrical.
5. Swelling typical, and with more or less fusiform appearance.	5. Swelling as if solid enlargement of normal joint.
6. Deformity varying.	6. Greater tendency to fixation of joints in flexed position. Fingers fixed in extreme flexion.
7. Edema early and constant symptom.	7. Edema, if present, a later symptom, and never so intense.
8. Many neurotic symptoms, especially early in the disease—sweating, headache, tingling, numbness, pigmentation of skin, etc.	8. Wanting; no headache, etc.
9. Very rarely subacute attacks.	9. Greater tendency to subacute attacks.
10. Heart normal, but rapid in action.	10. Heart often diseased.
11. Hard, rapid pulse.	11. Pulse varies according to state of heart.
12. Reflexes normal or subnormal.	12. Reflexes increased, especially later in the disease.
13. Muscular atrophy concurrent with, and often previous to, joint affection; small muscles chiefly.	13. Muscular atrophy subsequent to joints being affected; often large muscles first.
14. Any age.	14. Adults and mostly over middle age.

Lane, quoted by J. C. Walton (Southern Med. and Surg., June, 1910).

The author has found often in chronic arthritis and nephritis foci of infection which he considers sources of the malady. The commonest foci

are the tonsil, the lymphoid tissues of the pharynx, abscesses of the gums, pyorrhea alveolaris, gingivitis, and the sinuses of the head; bronchiectatic cavities, chronic ulcers of the gastrointestinal tract, chronic appendicitis and cholecystitis, infections of the urinary and genital tracts, and, finally, local submucous or subcutaneous infections anywhere in the body. Streptococci from many of these patients, injected into animals, caused an arthritis of deforming type. Frank Billings (Archives of Intern. Med., May, 1912).

Of 24 typical cases of arthritis deformans, 6 reacted in complement-fixation tests to strains of *Streptococcus viridans*. From 4 of these cases the same organism was isolated from a tooth-socket after the extraction of teeth. Four other cases reacted to the gonococcus; one of them to streptococcus also. T. W. Hastings (Jour. Amer. Med. Assoc., April 19, 1913).

Infectious agents are the most important factors in this disease, but the micro-organisms present in different cases are not necessarily always the same. Both proliferative and degenerative phenomena may occur in the joints of the same individual in polyarthritis as well as in cases of monarticular disease. The localization of the infection varies. Nathan (Jour. Med. Research, May, 1917).

The focal infections which promote arthritis deformans and other arthritic diseases, are: (1) the throat, (2) the mouth, (3) the alimentary canal, and (4) the genito-urinary tract. In the throat the main causes are hypertrophy and ulceration of the tonsils and adenoids. All diseases of the middle ear and mastoid, meningitis, intracranial abscess, sinusitis, etc., are traceable directly to the throat. Tuberculous glands of the neck are now removed only after the tonsils have been eliminated as a source of infection. The main disease of the mouth, as a source of systemic infection, is pyorrhea. This may cause sore and painful joints,

arthritis deformans, endocarditis, intestinal indigestion, loss of teeth, antral disease, alveolar abscess, osteomyelitis, neuritis, neuralgia, glandular enlargement, endarteritis obliterans, and painful feet. In the alimentary canal constipation or intestinal stasis, which result in the accumulation of feces and putrefactive changes, are prominent causes.

In the genito-urinary tract gonorrhea is the main factor. S. L. McCurdy (Jour. Orthop. Surg., ii, 92, 1920).

The *atrophic form* is progressive and may go on for many years. It is multiple in its joint manifestations and affects both the large and small articulations. It especially attacks the fingers, producing spindle-shaped swellings, which appear like enlargements of the bones, but are really the result of effusion; the latter, becoming absorbed, leaves the part smaller than normal. The fibrous tissues and the cartilages become infiltrated, softened, and finally even the ends of the bones become absorbed; deformities and luxations are frequent. The adjoining ends of the bones seem to fuse together, and as the activity of the process subsides they remain more or less completely ankylosed. This process is not accompanied by any new bony formation, but by a loss or atrophy of bone. The disease may attack people of any age and is often seen in young adults, adolescents, and even quite young children. It is a disease that has marked exacerbations in which the parts present the signs of inflammation, accompanied by constitutional disturbance and fever. There is usually an absence of glandular enlargement.

Case of chronic joint disease involving practically all the joints of the body. The most striking feature

was wasting of the bones, especially marked in the hands. All the fingers were greatly shortened and some entire phalanges had apparently been absorbed. R. S. Lavenson (Jour. Amer. Med. Assoc., Jan. 26, 1907).

Gouty, rheumatic, and toxic forms of arthritis have been described as occurring in sthenic or asthenic patients and resulting in atrophic and hypertrophic changes. The rheumatic manifestations are, in general, earliest seen in the smaller joints, and can be readily detected in the phalangeal articulations by X-ray examination. The röntgenogram shows clearly the difference between the normal joint and the atrophic disease with absorption of cartilage and approximation of bones. C. L. Leonard (Monthly Cyclo. of Pract. Med., March, 1907).

The X-rays sometimes explain a soldier's limping as the result of a rapidly developing, deforming osteoarthritis of the hip joint. The deformity is of several different types, as explained with radiograms. It is a query whether it may not be a premature senile hip joint affection. The fatigues and overexertion of the campaign may have brought on premature senility in these tissues. Beaujard (Paris méd., Feb. 22, 1919).

The *hypertrophic form* does not possess, as a rule, the malignancy of the atrophic type. It does not occasion so much suffering, nor so great and numerous deformities; nor is it so active. It consists in a hypertrophy at its edges of the articular cartilage, which speedily becomes transformed into bone, producing projecting masses or "lipping," whence the name hypertrophic. These new-formed masses extend sometimes from one bone to another, forming a bony bridge, which firmly ankyloses them. Such a condition is seen in the spine, which may be transformed into one rigid mass of bone. This was called

by Marie "*spondylose rhizomélisque*." It is particularly prone to attack the hip-joint, often in old people,—hence the name *malum coxa senilis*. It produces the bony protuberances on the finger-joints called Heberden's nodes. It is a painful, ankylosing, and exceedingly crippling disease, which may progress more or less steadily for many years without fever.

Pathological and clinical study of 65 cases of chronic, non-tuberculous, deforming arthritis as a result of which the joint conditions found are classified as: (1) *Proliferative or hypertrophic arthritis*, in which the primary change is a proliferation of the synovial membrane and the perichondrium of the articular cavity, in many cases with synchronous proliferation of the connective tissue and endosteum of the epiphyseal marrow directly below the joint cartilage. The synovial membrane produces a layer of granulation tissue, which sooner or later may extend over the cartilage as a thin pannus-like layer, and produces destruction and absorption of the cartilage. The perichondrium forms a layer of specialized connective tissue, which readily changes into cartilage or even bone. The relative amount of destruction of cartilage and new formation of cartilage and bone varies in different joints and with different causes. Proliferation of the connective tissue of the marrow spaces of the epiphysis takes place. This resulting highly vascular granulation tissue may extend upward to the joint, causing destruction of the overlying cartilage. Such changes may occur in large or small joints, and be the end-result of joint infection by pus organisms or the gonococcus; in Still's disease; in single joints, large or small, where the process comes on insidiously without evidence of bacterial infection; and finally occur as a result of fractures in a joint, with partial dislocation of the articular facets. (2) *Degenerative*



Arthritis Deformans.

or atrophic arthritis. Here the primary change is degeneration of the hyaline cartilage of the articular surfaces, the underlying bone being exposed. The articular surface undergoes marked thickening of its bony trabeculae and the marrow spaces may be almost entirely obliterated, the exposed bone becoming very dense and highly polished, like ivory. Erosion of one portion of the joint surface with overgrowth of the remainder may lead to subluxation, or in some cases fixation of the joint. At the same time perichondrial changes take place, leading to new formation of cartilage, which may turn into bone, so that the heads of the bones may be irregularly increased in size. Such changes occur in old people or in young persons who are physiologically old, especially in those with associated central nervous disease. Nichols and Richardson (*Jour. Med. Research*, Sept., 1909).

In neither the trophic nor the hypertrophic form of osteoarthritis or arthritis deformans is an absolutely positive cause known. Evidences of infection, both as regards the blood and local manifestations, are lacking.

The chief objections to the infectious theory of this disease are that so many cases do not give a typical picture of infection, and that no one thus far has isolated any organism from the tissues or joints in a considerable number of consecutive cases. E. C. Rosenow (*Jour. Amer. Med. Assoc.*, April 11, 1914).

Neither has it been proven that nutritional disturbances are causative. In view of the fact that these conditions often arise after injuries it is probable that in some instances traumatism does act as a causative agent. The nutrition is often impaired and probably influences the character of the symptoms. In some cases nervous disturbances are prominent. In the

absence, however, of any positive evidence of an infective element, we must for the present assume that a disturbed nutrition is the basis of the disease, and the treatment is largely founded on this view.

Certain joint affections in women develop during the menopause or immediately afterward. Heberden's nodes are often the only external manifestation of the menopause. In but few of these joint affections is there a traumatic factor. Local lipomatosis is a frequent accompaniment, especially in the lower limbs. The joints may develop arborescent lipomata and enlargement of the finger-joints may be observed. The author witnessed these joint affections in unmistakable connection with the menopause in 47 cases; also in 6 cases of artificial menopause through oöphorectomy. **Ovarian extract** is a powerful adjuvant in these cases. Measures which raise the temperature of the body for a considerable time produce good effects. Neumann (*Med. Klinik*, March 22, 1908).

Still's disease described as follows: It usually begins before the second dentition, and occurs oftener in girls than boys. The onset is usually insidious, with stiffness of one or more joints, though occasionally it is sudden, with high fever. The joint enlargement suggests rather thickening of the tissues around the joints than changes in bone or cartilage. Bony grating usually absent, and effusion not marked. Tenderness only slight. Joints first involved are the knees, wrists, and cervical spines. The fingers, and later on the toes, become affected. The disease is probably never limited to one joint, and is almost always symmetrical. No tendency to suppuration or bony ankylosis. Usually muscular atrophy with tendency to contracture. Lymphatic glandular enlargement a constant symptom, the glands oftenest affected being those

near the involved joints. Spleen always palpable, and its size is proportionate to the joint involvement and number of glands involved. Pleuritis and pericarditis of a low grade may occur. Progress of disease is slow and in time tends to remain stationary, leaving the individual helpless. Exophthalmos, with rapid pulse, at times noted.

The children should be placed upon **iodide** and, when possible, removed to a **warmer climate**. The conditions of hygiene should be improved. I. A. Abt (*Interstate Med. Jour.*, July, 1908).

The polyarthritis described by Still seems to result from a chronic sepsis, which, while not sufficiently potent to completely overpower the young organism, has destroyed resistance by enfeebling the phagocytic power of the blood and lowering lymphatic activity. The prognosis is not necessarily hopeless. Pisek (*Arch. of Diag.*, Oct., 1909).

TREATMENT.—In both the atrophic and hypertrophic forms the principles of treatment should be protection of the affected parts and an endeavor to build up and restore the impaired nutrition. The greatest attention should be given to personal hygiene and feeding. Pemberton has recently found that, particularly in old cases, **free purgation**, or **lavage of the colon** and a **strict diet** markedly improve the condition of the patient thus afflicted.

Most clinicians agree with Billings when he states: "The treatment and management must comprise: (a) the **removal of the cause**; (b) improvement of the immunity by **rest**, personal hygiene, good food, **pure air**, and sunshine, rational calisthenics and physical culture, moral support and a cheerful environment. **Auto-genous vaccination** may be used to improve immunity still further."

Rheumatoid arthritis, if recognized early in the acute stage, is curable. In the later stages it may be arrested, but the deformed joints cannot be restored. The best drugs are **guaiacol** and **potassium iodide**. Luff (*Brit. Med. Jour.*, Oct. 26, 1907).

Case of arthritis deformans following influenza, with marked constipation and offensive and slimy motions, in which daily **colonic lavage** through a 4½-foot esophageal tube, with 3 quarts of warm water in which 3 tablespoonfuls of **Epsom salts** had been dissolved, together with a tablespoonful of **castor oil** and 2 compound **betanaphthol** tablets, three times a day, caused all the symptoms to improve rapidly. The joints gradually became less painful and tender and the swelling and effusion slowly subsided. F. Booth (*Lancet*, Dec. 19, 1908).

Dried **thymus gland** used in arthritis deformans. Continuous administration sooner or later led to definite and, in some cases, striking improvement. It is only when it is taken for months that the joint disability begins to disappear. If it is discontinued the symptoms then reappear. **Rest** is important. It is rarely necessary to absolutely immobilize the joint, but patients with the active disease should not engage in manual work. When all signs of active disease have disappeared for some time, a very gradual return of function should be made and, in old cases with contractions, especially in the legs, these must be corrected, remembering, however, that the ends of the bones are soft and friable and the use of force may be dangerous. During the treatment a nutritious mixed **diet** should be given. Among 106 cases, 3 out of 18 bedridden patients are now walking without cane or crutch. Of 14 wheel-chair patients, results are unknown in 4, 3 are walking without assistance, and 2 are walking with a cane; in 2 the joints are without pain, and 3 have died. Of the remaining 51 severe cases, practically all improved under

treatment. Thirty-three of the remaining milder cases have been practically well for a year or more; in only 7 was the treatment unsuccessful. The dose of thymus is 2 to 4 tabloids of 5 grains (0.3 Gm.) each, three times a day, either before or after meals. P. W. Nathan (Jour. Amer. Med. Assoc., June 17, 1911).

Of importance in the treatment of intestinal indigestion causing arthritis is the substitution, for the usual diet, of milk products containing lactic acid-producing organisms. **Buttermilk**, where obtainable, is of great service. A taste for sour milk, which is perhaps equally useful, can quickly be acquired. Sour-milk curds are readily taken, covered with milk-sugar. The following simple way of producing fermented milks is used with success by Hunkin: A half-pound of cream cheese is cut into small pieces and stirred into a pint of fresh milk. This is kept warm for three hours and then put in a cold place. Next day a cupful of this mixture is added to a quart of fresh milk and the same performance gone through. This is repeated for three days and on the fourth the strain of lactic acid-producing organisms is a very active and reliable one. On this day a cupful of the mixture is added to 3 or 4 quarts of fresh milk, which, after twenty-four hours, is ready for use. C. C. Crane (Calif. State Jour. of Med., Sept., 1911).

There is an abnormal amount of lime salts in the articular cartilages in deforming arthritis. Limitation of the lime in the diet was found efficacious in this and certain other forms of arthritis. The patients stay in bed for three days on a test ration of rice, chopped beef, bread and meat-extract bouillon, 1 liter (quart) milk, etc., only distilled water being used in cooking. The ration contains about 1.86 Gm. (29 grains) of CaO. If no more than 10 per cent. of this amount is eliminated in the urine, there must be lime retention, and a **lime-poor**

diet is ordered for six or eight weeks, using distilled water and strictly avoiding milk, butter, yolk of eggs, potatoes and spinach, as well as eating very sparingly of other vegetables. Marked benefit is likely in cases of chronic ankylosis of the spine, deforming arthritis and the joint pains persisting after an acute polyarthritis. M. Hirschberg (Berl. klin. Woch., Nov. 13, 1911).

Thyroid preparations are useful in many cases of long-standing osteoarthritis and chronic infectious arthritis, probably because of damage to the thyroid gland resulting from its hyperactivity attendant upon continued toxemia. Slow pulse is an indication of thyroid failure; emaciation does not preclude it. Dosage of dried thyroid substance ranges from 1½ grains (0.1 Gm.) once daily up to 5 grains (0.3 Gm.) *t. i. d.* in distinct myxedema. Avoid causing headache, diarrhea, or reduction of blood-pressure, and intermit drug from time to time. Thyroid medication is necessary for the remainder of the patient's life where thyroid failure is thoroughly established. Midelton (Practitioner, Jan., 1912).

In arthritis deformans the author has each patient given 2 or 3 **high enemata** a week, as a result of which the pain in the joints is greatly relieved. The following measures are also employed: **Baking** followed by **massage** three times a week; "**steam boxes**" on the intervening days; **light baths** twice a week; **Bier's hyperemia** every day for six or twelve hours; **exercises** daily, and **static electricity** three times a week. Goorstein (Med. Record, Feb. 10, 1912).

Case of a man aged 44 years with arthritis deformans, who began three years ago to have an arthritis in the right wrist, gradually extending to all joints of the body. There were continual pains in the joints and muscles and through the neck and chest, and the patient had lost 37 pounds in weight.

Blood was withdrawn from the median vein with a hypodermic

syringe, incubated, and allowed to remain for twenty-four hours, and the serum poured off, plated and again incubated. Examination showed two organisms, a bacillus and a diplococcus probably isolated by Poynton and Payne from the synovial membranes. A **bacterin** was prepared from these organisms and treatment instituted. After two weeks the pain had entirely left. The right wrist, apparently completely ankylosed, markedly limbered up, and the swelling disappeared. The patient gained in weight and steadily improved. Other patients treated similarly. Greene (New York Med. Jour., Aug. 31, 1912).

In rheumatoid arthritis the teeth should receive scrupulous attention and acid fermentation in the stomach eliminated by cutting off all saccharin and farinaceous articles of diet, and placing the patient for a few days on an abundance of red meat with plenty of hot water. Red meat produces ammonia, which neutralizes the sarcolactic acid in the muscles. Then milk should be used, to which some sodium bicarbonate and chalk or lime-water have been added; also junket and cream. Afterward green vegetables and farinaceous food, except oatmeal, and a fair amount of fat should be given, especially olive oil or codliver oil; at least an ounce of these oils should be given every night at bedtime. Bacon gravy, fat bacon, cream, butter, and margarine are valuable adjuncts, but beef or mutton fats had better be eschewed. The patient should take a liberal allowance of table salt with meals. All acids and acid fruits, rhubarb, tomatoes, and asparagus should be avoided. Glucose and honey are better than cane-sugar or jams. When the patient is improving, grapes, bananas, nuts, stewed prunes, and figs may be allowed; saccharin is better than sugar, especially when the urine has become alkaline under treatment, and tends to deposit phosphates. As a drink, there is nothing better than pure

water, especially when hot, or weak tea, milk, and soda water (containing about 30 grains of sodium bicarbonate to the pint), plain barley water, and raisin tea. To correct the acid fermentation and improve gastric motility, a good combination consists of **sodium bicarbonate** and 15 or 30 grains (1 or 2 Gm.) of aromatic chalk in a glass of milk about half an hour before meals, with a double dose at bedtime. A stomachic of **calcium chloride**, **hydrochloric acid**, and minute doses of the **perchloride of iron** is very useful after meals. A small cholagogue pill should be administered regularly, *e.g.*, one made with the **sulphate**, **bicarbonate**, and **salicylate of sodium** and licorice. It is imperative to get line into the tissues. For this the author prescribes freely **chloride of sodium** and **potassium**, **sodium bicarbonate**, **chalk**, **lactate of lime**, and **calcium glycerophosphate**. Iron is best administered in the form of underdone red meat, and yolk of eggs. Arsenic, potassium iodide, guaiacol, and a host of remedies commonly prescribed are worse than useless. Barr (Brit. Med. Jour., April 12, 1913).

In rheumatoid arthritis the offending organism or organisms should, if possible, be isolated from the primary focus of infection and an **autogenous vaccine** given for one or two doses. This will raise the phagocytic powers of the patient, and it is then time to give the infected region local treatment. The vaccines must be continued for long periods. Hughes (Brit. Med. Jour., 2737, 1267, 1913).

Gradual but permanent improvement noted in a number of cases after administration of **thymus extract**. Pain and swelling disappear and appetite returns. Nucleoproteid extract much preferable to crude gland. Treatment should cover several months, and small doses be continued for some time after apparent cure. Berkeley (Monthly Cyclo. and Med. Bull., Jan., 1914).

It is important to bear in mind that the joint is to be protected from disturbing movements. It is here that osteoarthritis differs from simple traumatic disease of the joints. In the latter a small amount of movement may not be painful, but in the former the opposite is the case. Massage is not apt to be of service except in chronic cases,—certainly not in acute ones. Rest on a **splint** is to be enforced, with the joint **wrapped up in cotton or flannel**. The application of **cloths wrung out of hot alkaline solutions** may be tried. A piece of lint wet with **chloroform liniment** and covered with **woolen cloths** may give relief. **Fixation** of the joint with plaster-of-Paris casts, persisted in for a long period, is one of the very best means of treatment we possess. Sometimes this fixation can be better or more conveniently accomplished by means of some apparatus, such as a brace for the spine. At other times an operation that serves to ankylose or stiffen the joint removes the pain and allows locomotion. Albee has devised such an operation for the hip-joint. Osler advises the use of the **Paquelin cautery**, lightly and rapidly stroked over the part, as a means of reducing pain. The use of leeches is not so efficacious as in traumatic cases. **Cold applications** are only to be advised when not distressing to the patient.

Crude **pyroligneous acid** recommended as affording relief from pain and stiffness in arthritis deformans. Redness of the joints disappears, swelling diminishes, and fibrous ankylosis relaxes or can be broken up with but little pain or reactionary hyperemia. Restoration of function well shown in the hands and fingers. Six patients cited in whom benefit followed exhibition of pyroligneous

acid. The usual dose was 2 teaspoonfuls three times daily. Kolipinski (*Monthly Cyclo. of Pract. Med.*, Oct., 1907).

Two cases of Still's disease in which **fresh air, arsenic, massage, and passive movements** produced prompt results—slight in one case, marked in the other. Hingston (*Arch. of Pediat.*, June, 1909).

Sulphur waters, in combination with **massage, gymnastics, stasis, and electricity**, recommended in the treatment of the chronic forms of arthritis. **Fibrolysin** injections, especially in the more chronic progressive cases, found a valuable adjuvant. As a rule, 30 injections of 2.33 c.c. (37 minims) each were given, daily, into the gluteal muscles. Improvement generally noticed only after the twentieth injection. Cases of valvular disease and lung trouble stood the injections well. The joint swelling disappears, mobility returns, and general improvement is noticed. A. Schawlow (*Deut. med. Woch.*, No. 14, 1909).

In many cases the progress of arthritis deformans can be stopped by removal of offending appendices, hemorrhoids, and other causes of irritation. In advanced cases where the cause is no longer operative, or obscure, the most effective method of treatment is to relieve the pain, thereby securing a return to good nutrition. This is best done by applying an absolutely rigid close-fitting **retention dressing** with the limb in such a position that the antagonistic muscles surrounding the joint are in absolute equilibrium. If the limbs cannot be brought into the desired position without extreme pain, contractures are broken up under anesthesia, tendons are lengthened, if necessary, by tendoplasty, and a plaster-of-Paris dressing applied in the desired position and allowed to remain there until pain and irritation have subsided. A new plaster mold reinforced with basket splints and wheat gluten bandages is then applied over stockinet. In immobilizing the up-

per extremity a small pad is placed in the axilla, a shoulder-cap applied and fastened to the chest with roller bandage; the elbow is placed at a less than a right angle, the forearm rotated inward slightly, the thumb extended, the fingers held perfectly straight, and a mold applied in this position. To immobilize the hip the author uses a plaster-of-Paris spica extending from the umbilicus to the pubis and to within an inch of the knee, with the thigh abducted 10 degrees and ventral flexion of 5 degrees. The knee is placed at 175 degrees and the ankle at 85 degrees. Ochsner (Jour. Amer. Med. Assoc., March 5, 1910).

Arthritis deformans may develop independently of infection or intoxication, solely from static disturbances. Such a disturbance in the foot may react on a joint above. Pain is not caused until the synovial membrane becomes irritated. The Röntgen rays may reveal deforming arthritis for years without pain or functional disturbance, pain then suddenly developing from slight trauma. **Massage, superheated air, and passive exercises** for weeks may be necessary before the limb can be used again, and these measures do not influence materially the osteoarthritis itself. Ewald (Deut. med. Woch., May 12, 1910).

The treatment which has given the author most satisfaction in arthritis deformans is: **Rest** in bed for at least ten hours out of the twenty-four. A **diet** as generous as can be digested and assimilated without producing putrefaction or fermentation. From $\frac{1}{30}$ to $\frac{1}{10}$ grain (0.0022 to 0.0016 Gm.) of **strychnine sulphate** and 2 or 3 grains (0.13 or 0.2 Gm.) of **ferrous iodide** three times daily, half an hour before meals; and in emaciated cases from 1 to 4 drams (4 to 16 c.c.) of **codliver oil**, after meals. A dose of some one of the various **mineral waters**, before breakfast, every two or three days, if constipation is present. A **body dry, hot air treatment** two or three times weekly.

Central galvanization once or twice weekly. General **mechanical vibratory stimulation** two or three times weekly. A **static electric application** at least once every day, consisting, in acute cases, of the Morton wave current over the affected joints or spine and in the chronic cases of long, thick sparks to the affected joints one day and the Morton wave current localized over these joints the next. In some cases one of the **high-frequency currents**, applied either locally or generally, may advantageously replace some of these static applications, or be added to them. A **hot and cold douche** to the spine two or three times weekly.

For pain due to muscular spasm occurring during sleep, **strontium bromide** in 20- to 30- grain (1.3 to 2 Gm.) doses, repeated hourly until relieved or 3 doses have been taken, will usually succeed.

A mechanical procedure often helpful consists of **bandaging** the **affected muscles** snugly (not tightly enough to interfere with the circulation) when the patient prepares for the night. Skinner (Amer. Jour. Med. Sci., Nov., 1910).

Movements of otherwise rigid, painful joints are possible in hot water, and great benefit is derived from such exercise. Plate (Med. Klinik, Oct. 22, 1911).

A patient had been through the usual treatment for marked arthritis deformans without benefit, being much bent and using a cane. Subsequent treatment, consisting solely of the **static** and **high-frequency coil currents** caused great improvement. The condition was due to continued absorption of toxins from roots of teeth. A. H. Hirsh (N. Y. Med. Jour., Oct. 4, 1913).

In all of the writer's cases the most common source of infection was the colon. In the order of their frequency, the organisms found were the *Bacillus aerogenes capsulatus*, single Gram-positive cocci and diplococci, the *Bacillus putrificus*, pathogenic types of the *Bacillus coli* com-

munis, staphylococci, and streptococci. The etiological factor is probably a focal infection in the intestinal canal. A manifest focus of infection should be treated surgically and if no benefit is then noticed, the stools and urine should be examined to determine the presence of a colonic disorder. Having found that colon infection often is responsible for polyarthritis, the writer orders a **diet high in calories, but low in calcium**, and strains of variable **bacillus coli** administered **by rectum**, with considerable success. Bassler (Amer. Jour. Med. Sci., Sept., 1920).

The utility of hot-air baths must be determined by a cautious trial. At first the heat should not be great, and in many cases, particularly acute or subacute ones, local hot-air baths are not to be used at all. General **hot-air baths** and also **Turkish baths** are far more apt to be of service in all cases.

Too vigorous local treatment is very apt to relight the trouble; coaxing, and not forcing, is our motto. This is true also of passive motion. What is gained by gentle, persistent motion is apt to be retained, but what is acquired by forcible movements under anesthesia is apt to be lost, the joint becoming as stiff as before. It is, however, often of great service to anesthetize the patient and straighten out a bent limb, as in the case of knee contractions.

Notwithstanding the assertion of Treves that rheumatism and gout have practically no effect on the immediate future of an operation, care should be exercised. In disabilities resulting from loss of motion in joints, partial operations are apt to be extremely unsatisfactory,—only starting the trouble anew, as I have observed,—and total removal is more satisfactory. Thus, in the elbow-joint

formal **excision** is apt to give a better result than the removal of exostoses. In one case I deliberately excised the joint of the big toe for an intractable rheumatic inflammation that had lasted over a year, resulting in partial disorganization of the joint. While articular rheumatism is generally regarded as a septic infection, the practice of tapping and washing the joint with a mild antiseptic solution is to be followed only with caution and in selected cases where effusion is marked.

Fermented-milk diet advised in arthritis deformans. **Guaiaicol carbonate** is of some use in the acute stages. In the chronic, **arsenic** and **iron**, or **Donovan's solution**, are of service. Many patients do well on **codliver oil**, but will not tolerate potassium iodide. The joints should never be fixed, but when tender and painful demand **compression by layers of cotton** and an **elastic bandage**. The objects of surgical intervention are: (1) To rid joint of the products of inflammation; great improvement takes place after the drainage of even one joint; (2) to remove hypertrophied villi and osteophytes which interfere with function and produce erosion; (3) to correct deformity. Tubby (Lancet, Dec. 26, 1908).

Operation for arthritis deformans and other deforming affections of the hip employed in 16 cases. One patient died 10 weeks after operation, probably from nephritis. The others are cured. The procedure is applicable in advanced arthritis deformans, extreme paralysis of both hips, dislocation following suppurative arthritis of infancy, fibrous ankylosis, and selected cases of tuberculous arthritis in adults. The joint is reached by the anterior route, the capsule opened, and the head exposed by forced adduction, without, however, dislocating it. About one-half the upper surface of the head is removed, and a corresponding part of the up-

per edge of the acetabular cavity denuded of cartilage. The head is further exposed by outward rotation and denuded as much as possible of its cartilage. After closure the limb is placed in splints at about 15 degrees of flexion and in extreme abduction. F. H. Albee (*Surg., Gynec., and Obstet.*, March, 1910).

The writer reports 8 cases, with recovery in all, of **resection** of the hip joint for septic osteoarthritis. The men subjected to the operation late had previously had an arthrotomy, which though apparently promising at first, had eventually failed. In 3 cases the femoral head and the neck, partly or wholly, were alone resected. In 4 the great trochanter above the surgical neck had also to be taken out, and in a fifth, the less trochanter as well. Guénard (*Presse méd.*, May 17, 1917).

GOUT, ARTHRITIS OF.

Gout is certainly less common in this country than abroad. On this account it may not be recognized at first sight. It attacks all the joints, but most frequently the metatarsophalangeal joint of the big toe. It may present itself in an acute form, affecting only one joint, or in a more chronic form. The latter may be preceded by the former, the chronic form of the disease being then largely the remains of several acute attacks. Gouty conditions are often overlooked. Many of the pains that are experienced in various parts of the body, including the region of the joints, are manifestations of a gouty condition. Contraction (Dupuytren's) of the palmar fascia and hard, fibrous nodules occurring in the palms of the hands and soles of the feet are evidences of its presence. The changes produced in the parts are marked, as is also at times the resultant disability. The cartilages

are apt to be first attacked and subsequently the surrounding structures. Urate of sodium is deposited in the joint on the articular cartilages and through them, in the capsular ligaments, and even in the surrounding tissues. To such an extent is the latter condition the case that gouty nodules of urate of sodium deposited on the knuckles not infrequently ulcerate through the skin.

The treatment of an acute attack is to be sedative, but not too depleting. This subject is fully treated under GOUT. Surgical measures are rarely required. When the chalky deposits are marked, and, if they are loose, the skin may be incised and the deposit turned out. Care should be taken not to injure the skin over these deposits, or it may ulcerate and leave an exceedingly annoying sinus.

Radium emanations used in a large number of cases of chronic arthritis and gout. The patient was usually subjected to them in a closed room for two hours, the total number of sittings for each case being 24 to 36. Injections of soluble radium salts near the involved joints were also given, and superheated air, electric light, and brine baths administered. Absolute **rest** in bed was found to be a good adjuvant. Cases of long standing with marked joint alterations are not suited for the treatment, as a severe local reaction may occur. The blood of 50 cases of gout was examined; whereas before treatment it had contained much sodium monourate, after treatment this had disappeared in 37 instances. While the radium emanations are of great service, **dietetic measures** should not be overlooked. F. Gudzent (*Berl. klin. Woch.*, Nov. 20, 1911).

X-ray observations in 18 cases of gouty arthritis all showed that the uric deposits have a destructive influence on the bone beneath. This

suggests removing gouty tophi to prevent further injury of the joint. Often röntgenoscopy alone cleared up the diagnosis when the clinical picture seemed merely chronic rheumatic arthritis; in other cases the diagnosis of gout was not confirmed by röntgenoscopy. Jacobsohn (Mittel. a. d. Grenzgeb. d. Med. u. Chir., Bd. xxvi, Nu. 3, 1913).

CHARCOT'S DISEASE.

This name is applied to the joint affections which at times accompany locomotor ataxia. Charcot estimated that they occurred in 10 per cent. of the cases of ataxia, but in this country, at any rate, the proportion is much smaller. The changes produced in the joint resemble to a considerable extent those present in osteoarthritis. The course of the affection, however, is different. There are the same cartilaginous changes, with first fibrillation and then disappearance. There is a marked increase of synovial fluid, which bulges out the joint usually more than in osteoarthritis, and there are the same ridges of bone, with occasional nodules. The disorganization of the joint is apt to be more rapid and more pronounced. Whereas a joint affected with osteoarthritis tends to ankylose, that affected with Charcot's disease becomes loose and flail-like. Pain is a marked symptom in the former condition; in the latter it is only present to any extent in the early stages, to be replaced later by anesthesia. Even the bones wear away, as if from pressure. The disease usually attacks single joints, but both knees may be affected, or the elbow and fingers. At times its course is rapid, disorganization occurring in a few weeks, and this independently of use of the joints. These cases are of particular interest

to the surgeon, as he may be consulted before the ataxic disease has been recognized, and the true character of the affection is apt to be overlooked. Whenever an adult patient comes with a joint largely distended with fluid, with comparatively slight pain, and with symptoms apparently too mild for the evident destructive lesions present, one should search for ataxic symptoms.

Tabetic arthropathies may be the only sign of tabes dorsalis; they occur usually at the earliest stage of the spinal disease. In a few hours the joint may be enlarged to twice its normal size. Subcutaneous edema appears, the synovial secretion rapidly distends the synovial sac, bursts this, and then infiltrates the neighboring parts. The articular cartilages and adjacent bony parts undergo either atrophic or hypertrophic changes. Sometimes the joint swelling subsides and does not reappear; at others it subsides but reappears; at others still it remains in a chronic condition. Necessity of differentiating true tabetic arthropathies from syphilitic arthropathies occurring in a patient the subject of tabes emphasized, the latter improving markedly under **mercurial treatment**. Raymond (Jour. des prat., Oct. 20, 1906).

The painlessness of tabetic joints tends to lead the patients to use them unless strictly warned against it. Any joint is liable to be affected, but the larger ones more than the smaller. Two special forms are the tabetic foot, in which the bones of the arch are particularly involved, and the tabetic spine, differing from other types of spondylitis deformans in the sudden onset, extensive destruction of the parts, and the associated tabetic symptoms. The joint lesions of syringomyelia are very similar to those of tabes, but the common occurrence of pain, the predominance of involvement of the upper extremities (80 per cent. of the cases), and the longer course of the affec-

tion are notable differences. The treatment is **rest, orthopedic measures, and the avoidance of trauma.** L. F. Barker (Jour. Amer. Med. Assoc., Feb. 2, 1907).

Locomotor ataxia manifests itself by inco-ordination of movements; by want of ability to maintain balance, especially with the eyes closed; by shooting pains in the lower extremities, and by gastric disturbances. The pupils do not react to light, but do to accommodation,—the Argyll-Robertson pupil. The reflexes become lost; there may be ptosis or strabismus, or even a commencing optic atrophy, and, as the disease advances, paraplegia with loss of control of the sphincters supervenes. (See **TABES DORSALIS.**)

TREATMENT.—The disease is practically incurable. When it seems very active, complete **rest** may be enjoined, but when it is slow, **supports** may be applied to the joints so that they can be used as long as possible. It is in the highest degree advisable not to subject these joints to operative procedures. It is a great temptation to recommend the removal of a limb in which the knee-joint is absolutely disorganized; but doing so may result in the death of the patient, because the attempt at healing may be slight or totally lacking.

Good results obtained by the **Pirogoff amputation** in tabetic arthropathy of the ankle-joint. The stumps heal and become capable of weight-bearing. There is no trophic change in the skin and the X-rays show the bones to be healthy. The principle governing resection or amputation in neuropathic cases is that thorough fixation of the bony parts must be secured for healing to take place. When motion and friction occur, a false joint is almost certain to result. In the Pirogoff amputation the frag-

ment of the calcaneum should be nailed to the tibia to prevent movement through contraction of the muscles. Oehlecker (Beiträge z. klin. Chir., Bd. lxx, Hft. 1, 1910).

Conservative and palliative treatment is to be advised and the joint given all the support possible. Of course, the treatment proper for tabes is to be applied, as well as local attention given to the affected joint.

When the effusion in "Charcot joint" is extreme, temporary benefit may be obtained by **tapping** and **injection of phenol**, as in the treatment advocated for hydrarthrosis. **Joint-fixation** by proper appliances or retentive dressings may be of avail in locomotion. When the disease is limited to the knee, recourse may be had to **excision** with a hope of securing a firm limb. Rotter has thus excised the knee in 4 cases, with fair results in 2. F. E. Leavitt (Jour. Minn. State Med. Assoc. and N. W. Lancet, July 1, 1908).

Mercurial treatment seemed to benefit in some cases of tabetic joint disturbance, but aggravated the symptoms in others. Cedrangolo (Riforma Medica, May 9, 1910).

Case of a tabetic patient with involvement of the right ankle in which cure was effected by **massage** and **re-education of the muscles** of the region. The muscles that have lost their tone are carefully sought out and systematically massaged, avoiding the others. Prompt treatment of this kind is urged in all cases unless the joint is actually destroyed. In mild cases the cure may be practically complete in less than three weeks; in others six months or more may be required. Kouindjy (Presse méd., March 30, 1912).

SEPTIC ARTHRITIS.

The joints are frequently attacked by an inflammation of a septic character while there coexists a septic disease affecting the body generally. This infection is caused by a pus-

producing organism, the staphylococcus. Pyemia, typhoid and other fevers, and the puerperal state are diseases often accompanied by septic joint affections.

Inasmuch as the condition is much the same in all, they present, to a great extent, similar symptoms. The joint becomes the seat of an effusion, usually with pain. Sometimes only one joint is affected. When this is the case the joint is apt to be a large one, *e.g.*, the knee or hip. This is frequently true in puerperal, typhoid, and other fevers. In pyemia several joints are apt to be attacked. The onset is likely to be very insidious, and may pass unnoticed, being masked by the symptoms of the general affection. The pain in the joint may produce a restlessness which may be attributed to nervous or other disturbance, so that the disease may be far advanced when recognized. Sometimes the local disease progresses with great rapidity, pus being present in the joint almost from the first.

Primary pneumococcal arthritis is apparently rare in adults, but in children, less uncommon. The path of infection is the blood-stream, to which the organisms gain access through some slight, unnoticed area of injury, probably in the mouth, nasopharynx, or middle ear. The infection is usually localized at first in one joint, and may remain so or become generalized. The death rate compares very favorably with that in secondary pneumococcal arthritis. This may be accounted for by the usual restriction of infection in the former, whereas the latter generally implies a septicemia. Pasteur and Courtauld (*Lancet*, June 23, 1906).

Suppurative arthritis may occur early in scarlet fever, and such cases are generally fatal, being undoubtedly pyemic. The so-called "scarlatinal

rheumatism" usually affects adults and older children. Its time of onset is the fifth, sixth, or seventh day of attack, just when the temperature is falling to normal. The arm is more often affected than the leg, the smaller joints than the large, and the wrists and metacarpal joints most of all; recovery is rapid. All **suppurating joints** should at once be **opened** and an appropriate **serum** given. For the slighter, more usual form, **sodium salicylate** may be given. Coutts (*Brit. Med. Jour.*, Oct. 15, 1910).

It is necessary to examine closely into the state of the teeth and gums in every attack of synovial inflammation of non-traumatic origin. Even when synovitis follows a blow, strain, or other non-penetrating injury, one should examine the teeth, mouth, and pharynx for possible portals of infection. Hemogenic infections of joints in some ways contrast markedly with septic processes arising through direct traumatic inoculation. Although the fever is generally high at first, it is not persistently so; the local temperature is not so high, nor is the local redness so marked, as a rule. In the traumatic infections the general aspect of the patient is worse and the pain more severe. A. E. Barker (*Pract.*, Feb., 1913).

Experimental arthritis produced in rabbits with streptococci from a milk epidemic of sore throat. There were no striking differences in the reactions produced by the various kinds of streptococci employed. Jackson (*Jour. of Infect. Dis.*, May, 1913).

Case of septic arthritis of the knee-joint following resection of the nasal septum. Fluctuation was evident on the ninth day after the operation. The joint was opened and pus found, with destruction of cartilages. Imperatori (*Laryngoscope*, Mar., 1917).

The joint swells, and effusion is usually easily diagnosed. On the contrary, the first symptom may be pain. Pain is a very constant symp-

tom of general sepsis, and pains in various parts of the body may be complained of before any definite joint disease is visible. The color of the skin over the joint is not apt to be changed at first; but if disorganization of the joint takes place, it may become red and edematous. In the hip-joint, which is exceedingly liable to involvement in typhoid fever, dislocation is very apt to occur. If the hip trouble occurs early in the course of the general disease, it may, as in one case in my own experience, be difficult to diagnose the condition from acute hip disease of tuberculous nature. Multiplicity of lesions always argues for a general infection; therefore, when more than one joint is affected, one is almost sure that the disease is only a local manifestation of a general condition rather than a distinct and separate local disease. Oftentimes if the general disease tends toward recovery, the local joint trouble may be more of the nature of a synovitis than an arthritis, and may pursue a mild course, particularly if only a single joint is affected. If, however, the general disease is grave, the local disease is of a purulent character almost from the start, and suppuration may persist a long time, until death finally ends all.

TREATMENT.—At the onset of the joint trouble measures should be taken to soothe the irritation of the joint and protect it. It may be surrounded with **cotton or lint wet with lead water**, and supported by leather or pasteboard **splints**. **Sand bags** may also be placed on either side and an **ice-cap** laid on the joint. Sometimes enveloping the part in **hot cloths** is most comfortable. A conservative course should be pursued

as long as the disease is not progressing too fast. If it assumes a chronic form the joint may be wrapped in lint spread with **belladonna** and **mercury ointment** or one of 10 to 20 per cent. **ichthyol**, and supported by a firm **bandage** and **splints**. If, however, the joint symptoms become very active, it should be **aspirated** and washed out with sterile **salt solution**, **boric acid**, or weak **bichloride solution**.

Septic arthritis may be purulent from the start or follow a serous synovitis. The aspirated fluid is usually sterile although, occasionally, the streptococcus, staphylococcus or gonococcus may be found. Irrigating the joint with 5 per cent. **phenol solution** followed by 50 per cent. **alcohol** and **normal saline** is of great value. In gonorrheal joints normal saline irrigations at 115° F. are also effective. After disinfection the capsule of the joint must be immediately closed tight and if a drain is used at all it should be placed outside the joint capsule for the purpose of taking care of the extracapsular infection. The joint should be put in a position of physiologic rest until the wound is healed. Later, **gentle passive motion**, along with **baking** and **massage**, will help recovery. If the ankle is involved the foot should be held in slight varus and at right angles to the leg; if the knee, it should be put in sufficient flexion to secure relaxation of the hamstring muscles. The hip should be in slight flexion, abducted 20 or 30 degrees and neither rotated inward nor outward. The shoulder should be abducted at right angles to the body and the arm brought slightly forward. In the elbow a right angle position should be secured with the hand midway between pronation and supination, and if the wrist is the joint involved the hand should be secured upon a cocked-up splint with the wrist hyperextended in order that the grasping power of the hand shall be maintained. R. B. Cofield (Ohio State Med. Jour., Mar., 1918).

If suppuration becomes marked, free incision with drainage may be necessary.

To efficiently drain the knee-joint the writer resorts to the following method: With the limb in the usual dorsal position, the deepest part of the synovial cavity is in front of the popliteal space, much below the level of the suprapatellar pouch. Drainage is at present practically always effected by inserting a tube or tubes into the pouch above the patella, leaving much of the septic contents of the joint behind and between the femur and tibia with a tendency to make a way for itself to the surface by burrowing backwards into the popliteal space or along the course of the tendons in that region, upwards into the thigh, and downwards into the leg, or in both directions.

By changing the position of the limb, it is possible to make a suprapatellar pouch the dependent part of the joint, when by the very simple operation of inserting a tube into the top of the pouch the whole joint can be completely evacuated and purified, and if this is done sufficiently early, a speedy recovery may be anticipated with the joint's mobility unimpaired.

Two changes of position will make the suprapatellar pouch dependent: (a) The vertical position of the limb at right angles to the body with patient in the dorsal decubitus, or (b) The prone position of the body with the foot of the bed well raised.

In both positions the limb must be efficiently fixed on a splint, as fixation in knee inflammation is only second in importance to drainage.

When once the joint has been thoroughly evacuated of its septic contents, and if needful gently washed out with warm normal saline solution, the synovial membrane of the knee, like the peritoneum, is capable of taking care of itself. Long-continued drainage is very seldom required, and usually a movable joint will be obtained. A. W. Mayo-Robson (*Brit. Med. Jour.*, Oct. 6, 1917).

In these cases free stimulation to support the general strength is of the greatest importance, as the condition is apt to last quite a long while.

Mixed vaccine used in 9 cases of arthritis. Great relief followed in all. R. E. Brenneman (*N. Y. Med. Jour.*, Nov. 23, 1912).

SYPHILITIC ARTHRITIS.

Syphilis attacks the joints just as it does other tissues. It may occur in infancy, from heredity, in the secondary stage, or in the tertiary. In infancy, as well as to a somewhat less extent in adults, the disease is to be diagnosed and recognized not so much by its own peculiarities as by its surroundings and associations. If there is any point that may be more noticeable in it than in other affections of the joint, it is its less acute and less painful course. In infancy the joint, particularly the knee, may become swelled and somewhat—but not exceedingly—painful, nor very red, but be held stiff, and accompanied by atrophy of the muscles. There are usually present other manifestations of the disease, such as skin eruptions, eye affections, notched or pegged teeth, etc. A syphilitic history may also often be traced in the parents. As I have seen syphilitic arthritis in infancy it assumes mostly the synovial type and yields to specific treatment. The disease also attacks the joints in the secondary stage. It then shows itself as an effusion into the joints, resembling very much rheumatism, but not in a highly acute form. One's attention to its true character will probably be attracted by the other secondary symptoms. The disease of the joint will assume a mild acute or a subacute form. In the tertiary stage of syphilis the joint

disease is manifested by a deposit of gummatous tissue in the various parts of the joint. The swelling may be more irregular than in rheumatic disease, the deposit occurring in some portions of the joint while other portions are free. As a rule, it does not occasion suppuration, although ankylosis may occur. This may be fibrous or even bony.

There are forms of acute multiple arthritis due to syphilis in its late stage which bear a perfect or almost perfect resemblance to acute articular rheumatism. Suppuration does not take place. The whole course is milder than acute rheumatism, and the endocardium and serous membranes are not affected. Nocturnal exacerbations are also characteristic.

One should try **antisyphilitic treatment** in all cases of febrile inflammation of the joints exhibiting marked resistance to the usual treatment. W. Huzar (Wiener klin. Woch., Aug. 14, 1913).

Syphilitic lesions in and about joints are much more common than is realized. There is no definite pathologic picture. The diagnosis must be made by exclusion. There are two classes of cases: (1) those in which the joint is primarily affected; and (2) those in which the disease spreads from the surrounding parts. The main diagnostic point in syphilitic chronic synovitis is the absence of pain or much interference with motion. Pain if present is worse at night. No fluid but irregular lumpy thickenings are present in synovia. Too much stress should not be made on a negative Wassermann. Outside of the X-ray, the luetin test is the chief diagnostic aid. Before arriving at a diagnosis, tuberculosis, infectious arthritis, hypertrophic arthritis, and in children rickets and scurvy must be eliminated. E. S. Hatch (So. Med. Jour., xi, 431, 1918).

TREATMENT.—If the true nature of the disease is recognized, antisyph-

ilitic measures are to be employed. In infancy **mercurial inunctions** are best. In adults inunctions are desirable if it can be made convenient to use them,—if not, internal medication. The **biniodide of mercury**, beginning with about $\frac{1}{24}$ grain (0.0027 Gm.) and rapidly increasing to $\frac{1}{4}$ grain (0.016 Gm.) or more three times daily, is my preference. The **green iodide of mercury**, $\frac{1}{4}$ grain (0.016 Gm.) three times daily, or a mixture of **bichloride of mercury** and **iodide of potassium** or **sodium** in compound syrup of sarsaparilla, are also favorite forms of medication. In doubtful cases **iodide of potassium** or **sodium** should be given, as it is likely to be of benefit whether the case is one of syphilitic or rheumatic origin. Locally the methods used for other forms of arthritis are to be used, but the joint may be covered with lint spread with **belladonna** and **mercury ointment**.

In order to establish a correct diagnosis a Wassermann reaction test may be made, and if it be found positive, treatment by **salvarsan** injection may be resorted to. Especial care should be taken in administering the remedy to children.

Case of a woman who had suffered from an inflamed knee for eight months. Various drugs and other measures had been tried without result. Owing to a history of loss of teeth, metritis, and abortion after marriage, the writer tried hypodermic doses of **mercury biniodide**, 0.01 Gm. ($\frac{1}{6}$ grain), with **potassium iodide** internally; in ten days the patient was cured. Laignel-Lavastine (Jour. de méd. de Paris, July 20, 1912).

The treatment of the different forms of syphilitic arthritis varies according to the type of the disease. The effect of **mercury** upon hereditary joint

lesions is most beneficial and prompt. In the most common form, osteochondritis, after removing the necrotic tissue freely from the joint by surgical means, pain disappears and healing begins almost immediately after the administration of mercurial preparations. The joint should then be supported by a plaster-of-Paris case and contractions carefully guarded against in the chronic forms by suitable orthopedic apparatus. In the later stages, **massage, baking, and counterirritation** by means of **iodine** are beneficial. In Charcot's lesion of joints **spinal puncture** should be made for both diagnostic and therapeutic purposes. J. K. Young (Med. and Surg., i, 836, 1917).

TUBERCULOUS ARTHRITIS.

(See also HIP-JOINT DISEASE in the next article).

Tuberculous arthritis is the name given to what was formerly known as scrofulous or strumous disease of the joints. When the knee-joint was affected, it was called *tumor albus*; it has also been called *gelatinous arthritis*. It is now positively known that the characteristics of this disease are due to the tubercle bacillus, and that in its pathology it is a true tuberculosis affecting the bones and joints. The tuberculous process is a local one; it may and often does occur in company with other tuberculous manifestations elsewhere, but where this is the case it is late in the course of the disease. The tubercle bacillus becomes disseminated and starts up tuberculous processes elsewhere.

In the commencement, the joint, or the adjacent bone, is alone affected. The part becomes infiltrated with small cells; giant cells form; caseation, pus, and necrosis develop, and the bones become destroyed and the joint disorganized. The origin of the

disease process is of the greatest importance. Cases occur which look clinically as if the joint alone were involved,—as if it were the seat of a tuberculous synovitis and that alone. In other cases it is evident that disease of the bone is present, as well as of the synovial membrane. Almost all surgical authors describe these two forms of joint tuberculosis. Most of them regard the osseous form as being the more frequent, but also consider that the synovial form is very common.

H. Nichols, of Boston, has stated as his opinion that primary synovial tuberculosis is exceedingly uncommon, and that of 120 tuberculous joints he did not see one in which upon sawing open all the bones in thin layers one or more old bone foci were not found. I am inclined to believe that he is right in his opinion, and that those joints which have been examined and pronounced to be synovial tuberculosis would have shown in most cases bony involvement if the bone had been examined in a number of thin sections. Whatever the true pathology of tuberculous joint diseases is, they certainly manifest themselves clinically in the two forms.

Report of 13 cases confirming Poncet's assertions in regard to the existence of tuberculous rheumatism, the patients showing arthralgia, acute and subacute arthritis simulating rheumatic fever, or a chronic arthritis similar to various forms of chronic articular rheumatism. The cause of these phenomena is probably toxic, but their differentiation as being of tuberculous origin is important, in order that time be not wasted on salicylates, mercury, or antigonorrheal treatment. Schäffer (Hospitalstidende, June 10, 1908).

Case of "white swelling" of knee found due to sporotrichosis. Before operating on supposedly tuberculous joint lesions, possibility of sporotrichosis should be considered. Jeanselme and Chevallier (*Soc. méd. des Hôp. de Paris; Bull. méd., June 22, 1910*).

After a study of some 80 specimens of resected tuberculous joints, the author has been compelled to reject the theory that joint tuberculosis is of bony origin, and concludes that bone tuberculosis is simply a question of red or lymphoid marrow. Wherever one finds this in bone there one finds the bones vulnerable to tuberculosis. There is more red marrow in the bones of children than in those of adults, and hence more bone tuberculosis. Bony ankylosis may occur occasionally in children, but only after a secondary infection. It never occurs in adults except after infection. In a child anything from good function and practical cure up to bony ankylosis may be met with. In an adult, if bone is involved, painless and useful function in the joint is abolished forever and permanent healing under conservative treatment is very doubtful. L. W. Ely (*Jour. Amer. Med. Assoc., Aug. 26, 1911*).

Report of experimental work showing that local bone or joint tuberculosis is rarely the result of a generalized infection. In striking contrast to the bones, the joints are readily infected by direct inoculation with the tubercle bacillus. It is possible to infect the joints of a limb by infection of the main blood-vessel with tubercle. Fraser (*Jour. of Exper. Med., March, 1913*).

SYMPTOMS.—Joint tuberculosis, while essentially a chronic affection, still sometimes runs an acute course. When it does so, it may exhibit all the signs of inflammation, viz., heat, redness, swelling, pain, and disturbance of function. Commonly, however, the disease begins insidiously. Disturbance of function is apt to be

the first symptom, particularly if the hip or knee be affected. The skin ordinarily remains white (hence the old name of "white swelling"); the joint becomes swelled, due to the swelling of the synovial membrane and increase of fluid. Pain begins gradually, and, while sometimes almost entirely absent, at others is felt only on use of the joint. Redness occurs when pus has formed and is working its way toward the surface. This takes place usually at certain definite spots, which break down and form sinuses, leading down to carious bone and in cases of long standing directly into the joint. The pain is left in the joint itself, in the epiphyseal ends of the bones, and in certain cases in distant parts, *e.g.*, the pain along the inner side of the knee in hip disease. As the disease progresses, the joint becomes disorganized, pieces of bone exfoliate, sequestra are formed, the general health deteriorates, and in a certain number general tuberculosis ensues and causes death.

Usually traumatic joint tuberculosis develops immediately after the traumatism—as a rule, within the first fourteen days. There is probability of an etiological connection, even after two or three months. But in all these late cases, pain, swelling, or disturbance of function must have been present from the time of injury to that of the detection of the disease in order to establish the probability of the dependence of the disease on the injury. König (*Berl. klin. Woch., Sept. 14, 1908*).

Cases of static arthritis are commonly mistaken for rheumatism, gout, or sciatica. The term "static" signifies that the joint is imperfectly weighted, *i.e.*, its bearings are not right. This may result from improper balancing of the body, anomalous muscular pull, etc. A train of

secondary phenomena is set up. The joints form an element of lessened resistance, are readily injured, and also readily attacked in infectious processes like tuberculosis and gonorrhea. Strauss (*Berl. klin. Woch.*, Sept. 30, 1912).

Attention called to a possible error in mistaking anterior poliomyelitis, in the first few days of its course, for joint affections. The author has seen 3 cases of this disease that were brought on account of a painful limp, and had almost all the earmarks of a beginning tuberculosis of the hip. At the end of a week there were distinct evidences of anterior poliomyelitis and the children subsequently went through that disease.

He has also seen "hysterical" knees depending reflexly on a uterine lesion and disappearing after the uterus had been replaced. R. H. Sayre (*Jour. Amer. Med. Assoc.*, Nov. 8, 1913).

Almost any joint can become affected, but the most commonly attacked are the spine, hip, knee, ankle, elbow, and wrist. The small bones and joints of the foot and hand are also not seldom involved.

In some cases, especially where the lesions are multiple, doubt may arise as to whether the affection is syphilitic or tuberculous. In these the von Pirquet vaccination test is valuable in children for tuberculosis, and the Wassermann reaction is of service in both children and adults to prove the existence of syphilis.

TREATMENT.—Tuberculous disease of the bones and joints is not as serious a disease as is that of the lungs. The patients usually recover, though they are left in a more or less crippled condition, according to the severity of the affection. As so many patients preserve a fair state of general health while possessing a diseased joint, the local treatment is as important as the constitutional. In other words, in

selected cases the best way to improve the general health is to better the joint affection. Attempts to "build up the system" by medication while neglecting the local trouble will only end in disaster. The main element of local treatment is **rest**. Tuberculous attacks often follow injuries. Not only is this the case, but the disease is kept active by repeated, slight irritations due to movements and use of the part. Therefore protection is required. The more acute and marked the trouble, the more absolute must the rest be. It is practically impossible to secure this when the spine, knee, or hip is affected unless the patient is placed in bed. Parents, and even physicians sometimes, think that prolonged rest in bed will be injurious to the general health, but experience has abundantly proved that this is not so, and whenever it is possible to do so the patient should be put abed and kept on his back until all symptoms of activity of the disease have subsided. This should be done for months or even a year or two if necessary. To keep small children in bed and prevent their sitting up, it is desirable to fasten them down by means of a towel passed across the chest and pinned fast with safety pins to the mattress. **Bradford** devised a **frame** of iron gas-pipe to surround the child, covered with canvas or unbleached muslin. The child may be fastened to this by means of a sort of apron extending across the chest with straps passing over the shoulders. This is useful in affections of the hip as well as of the spine.

Extension is of service in diseases of the hip and knee; its object is to keep the joint-surfaces from being

pressed together by muscular contraction. Its good effect is at once seen by the diminution of pain. It allays muscular spasm. Even when the patient is allowed to go about, the same object is aimed at by the use of a suitable apparatus.

[As I stated at the meeting of the Philadelphia County Medical Society, of September 7, 1918, the orthopedic treatment of tuberculous cripples is of necessity carried on in institutions. For example, a child with Pott's disease should for a certain period of the treatment be confined to bed. If treatment were well carried out the case was almost certain to pursue a favorable course. Therefore, when a physician in general practice finds a child with tuberculous spine, he should have it placed under **hospital treatment**. It is a regrettable fact, however, that the needed hospital facilities are hard to get. Emphasis should be placed upon the importance of preventing irritation of the local spot of the disease. To get such a patient well, however, he must be treated constitutionally. He must be given **fresh air** and **sunlight**. With the solving of the hygienic question cure of the condition is possible. This is not sufficiently appreciated. GWILYM G. DAVIS.]

Tuberculosis of the ankle is more frequent than tuberculosis of the elbow- or shoulder- joint in children. Boys seem to be more subject to it than girls. About a fourth of 213 cases observed had other joints involved. The onset is usually slow and the most frequent location of the disease is the astragalus, the os calcis coming next. The cardinal symptoms are pain, soreness, limp, swelling, and muscle spasm. Chronic sprain, irritable flat-foot, syphilis, and infectious arthritis are to be ruled out by the history.

Conservative treatment is **preferable** to operative. Time is saved and the deformity less. There is also less danger of secondary joint involvement and general tuberculosis. When operations are done they should be clean. No curetting should be allowed and any bone or bones involved

should be removed *in toto* with as little mutilation as possible. Any deformity needing correction after a cure can be remedied by appropriate **tenotomies** or **osteotomies**, a sufficiently long time having elapsed to avoid any further lighting up of the original disease.

The prognosis in ankle tuberculosis is fairly good for life, but poor for a good ankle-joint without disability. A certain number get a good functional ankle, with but slight deformity. In regard to the smaller metatarsal bones the results are good for joint motion. J. W. Sever (Jour. Amer. Med. Assoc., Dec. 17, 1910).

Treatment by **fixation** in tuberculosis of the ankle in adults yielded a useful foot in only 3 cases out of 18, and time expended was at least four years. The commonest situation of the disease is in the astragalus, with extension to the os calcis, tibia, and fibula. An early **astragalectomy** would remove the disease, but in the author's series only 2 cases out of 8 had a favorable end-result following resection of the joint or astragalectomy. The diagnosis must be made earlier, when the X-ray shows a very small focus. This is the time when the choice between fixation and a more radical procedure must be made. Subsequent chronic invalidism can be avoided by outlining the treatment so that the end-result is obtained within one or two years. **Amputation** was necessary in over 50 per cent. of the author's cases. It should be advised when several joint surfaces, especially posterior to the astragalus, are invaded. The results are good from the patient's point of view. M. H. Rogers (Boston Med. and Surg. Jour., June 8, 1911).

Tuberculous disease of the *shoulder-joint* occurs often between the fourteenth and thirtieth years of life. In the variety that is of synovial origin, there is early effusion and limitation of movements, while in the bony type there is swelling of the soft parts and thickening without effusion, together with pain at night. **Extensive hy-**

drops is uncommon, but there is a marked tendency to destruction and disappearance of the head of the humerus. The early symptoms are those of joint weakness with slight stiffness and pain, followed by localized tenderness and muscular atrophy. The local treatment offers a better chance for recovery than in any other joint. The arm should be suspended in a **sling** secured to the side. **Blisters, counterirritants**, etc., can then easily be applied for the reduction of hyperemia, or **friction** or **passive movement** carried out. Where there is destruction of tissues a **free incision** should be made, and the diseased structures thoroughly removed.

In tuberculosis of the *elbow-joint* pain and tenderness over either of the humeral condyles or the olecranon may exist for many months before there is limitation of motion. Early symptoms are stiffness, limitation of motion, and pain, especially when the arm is extended, followed by a pulpy swelling on either side of the olecranon behind the joint, or of the whole joint. In cases where the X-ray shows loss of substance on the front of the humerus just above the elbow there is often but slight pain in ordinary movements, but there is stiffness from the outset and the limb is kept semiflexed and semipronated.

The treatment consists in **immobilization, tonic preparations, iodine, the actual cautery, mercurial inunction, strapping**, etc. In a few cases **passive motion**, used with great caution, is very beneficial. **Bier's hyperemia** has been highly recommended. The author early in the disease relies upon the injection of a 10 per cent. **iodoform in glycerin**, though if there is a sinus and mixed infection this measure does but little good. The joint is placed in the position of greatest ease. Sinuses should be dealt with by the open method, and all diseased structures removed. Where there is destruction of the joint, no other means but **amputation** remains. In childhood the disease may be very severe, with extensive abscesses and sinuses,

and yet in the end quiet down, leaving the joint practically as good as before.

In the *wrist-joint* the early symptoms are stiffness followed by slight uneasiness or pain, and, later, atrophy of the muscles and doughy swelling. Softening soon appears besides the extensor tendons, the bones enlarge, and severe continuous pain is felt on the slightest movement. The local treatment consists in a well-adjusted **splint, blisters, iodine**, etc. Early injection of **iodoform in glycerin** (10 per cent.) proved of great value in the author's hands. Should the disease advance, **incise** and remove every vestige of the disease. When greater destruction has occurred, **resect** lower ends of radius and ulna and remove some of the carpal bones. Occasionally, **amputation** of the forearm is required.

Tuberculosis of the *knee-joint* in younger patients generally begins in the lower femur or head of the tibia, occasionally in the patella, while in older patients the synovial membrane is usually affected. The joint becomes fixed, though it may bear weight without pain. The limb is placed in slight flexion, and tender spots may be discerned over the condyles of the femur or tibia. There is pain upon movement and the skin over the joint is slightly warm. Effusion in the joint now occurs and "floating of the patella" may be elicited when the limb is extended, with the heel supported. When the epiphysis of the femur or tibia is alone affected there is no appreciable alteration in the joint and movements are comparatively easy, but there are felt some thickening and tenderness, and there is pain when the weight is thrown on the limb, or hyperextension attempted. There is a sense of heat and throbbing in the end of the bone, especially at night, and in some cases tender spots are felt over the epiphyseal line. The joint then becomes swollen and bulbous and the muscles undergo partial atrophy. Moderate fever is noticed. The pain

is often in part a referred pain. The skin over the knee becomes white.

Perhaps the best device for **immobilization** is **Taylor's splint** or plaster of Paris. Even when abscesses had formed, but without sinus, injections of **iodoform in glycerin** gave the author excellent results. Sinuses, abscesses, and diseased bone are treated elsewhere. **Resection** or **amputation** may eventually be required.

Tuberculosis of the *ankle-joint* produces first pain on motion, with limitation of active and passive movements, a limp, and gradual swelling of the ankle and upper part of the foot. Finally, the swelling obliterates the malleoli and assumes a spindle shape. The treatment is absolute **rest** with a **splint** or **plaster-of-Paris dressing**, and the placing of the patient upon crutches, to obtain **fresh air** and **sunshine**. In some cases early use of **iodoform in glycerin** is quite beneficial, or the application of **counter-irritants**. Abscesses and sinuses are treated as in other joints; the disease advancing, **resection** or **removal** of some of the tarsal bones, or as a last resort **amputation**, may be resorted to. P. F. Eve (Southern Pract., July, 1912).

Study of a series of 50 cases of joint tuberculosis showed a wide margin of advantage for the patients not operated upon. As a time-saving expedient operation in adults proved a fallacy; the patients were disabled much longer than the average of patients conservatively treated. A large proportion of good results may be obtained by conservative treatment when the diagnosis is made early and the treatment carefully carried out. Equally good results may be obtained in patients requiring a minor surgical procedure, even in late cases, when it is combined with careful mechanical treatment and strict surgical after-care. H. W. Orr (Jour. Amer. Med. Assoc., Oct. 11, 1913).

Mechanical supports or **splints** of some kind are of the greatest serv-

ice. Plaster of Paris and silicate of soda are of great utility; likewise splints made of pasteboard, wood, or leather. When quick setting is required, or frequent changing, plaster of Paris is best. When the patient can remain in bed for twenty-four hours, and where quick setting is not required and the apparatus is to be worn for a considerable time, then silicate of soda is preferable. For the upper extremity splints of wood, pasteboard, or leather are applicable. These various dressings, however, can be used in any part of the body, and the choice will depend on the peculiarities of the individual case and the mechanical abilities of the surgeon. The dressings should all be so made so that they can be removed every day or two, in order that the parts may be inspected and bathed and excoriations prevented. In spinal disease, when the patient is not fastened down in bed, it is desirable that the apparatus be worn during the night as well as by day; this insures better rest to the diseased part.

Local applications do not play a very important part in the treatment. In *acute cases* evaporating lotions such as **lead water** may be applied, or an **ice-cap** laid on the **inflamed joint**. When the disease becomes more chronic, then **ointments** like **belladonna** and **mercury** and 10 per cent. **ichthyol** may be used, and the joint firmly bandaged with either a flannel or rubber bandage; or it may be **strapped** with adhesive plaster. Sometimes small **blisters** around the affected spot tend to relieve pain.

Fistulous and suppurating tuberculous processes can be treated advantageously by combining **constriction**

and **suction therapy**. The treatment should be begun early and continued even after all signs of inflammation have subsided. Deutschlander (Münch. med. Woch., Bd. liv, Nu. 16, 1907).

In using **Bier's hyperemia** in surgical tuberculosis, the band should be broad (6 cm.), soft, applied slowly and evenly around the extremity, proximally, but not close, to the tuberculous joint. It must not cause pain. It is applied once or twice daily, for from one to two hours. Considerable time is required for a cure, nine months or even longer. The treatment is inapplicable to the hip-joint. The best results are at the elbow and wrist. The exudative form (hydrops) is never thus treated. Von Schmieden (Med. Rec., Aug. 17, 1907).

The small joints retain their youthful conditions through life and are thus always liable to tuberculous invasion. In 2 out of 349 cases of joint tuberculosis, the infection was ascribed to vaccination. In some, traumatism was incriminated, but it was always comparatively slight. **Constriction hyperemia** recommended in the treatment, though it requires much attention on the part of the physician. The simple rubber band, 2 or 3 inches wide, is applied for an hour morning and evening. Vogel (Deut. Zeit. f. Chir., Dec., 1909).

In the treatment of tuberculous elbow joints there are 3 distinct indications: To increase resistance; to place the joint in the best possible position for future usefulness; and to prevent deformity. **Immobilization** is given the chief place, but it should be complete. Plaster of Paris is efficient in the early stages, **Bier's obstructive hyperemia** is of probable aid when thoroughly and efficiently used; surgical treatment for joint fixation in adults is helpful; otherwise surgery should be avoided as far as possible. Antiseptic injections are practically useless. Michael Casper (Amer. Jour. Surg., Feb., 1918).

Large effusions into a joint may be **tapped** under the strictest antiseptic precautions. If pus forms, the joint may be washed out with a 1:5000 solution of **bichloride of mercury**. The injection of **iodoform** and **glycerin emulsion**, 10 per cent., into and around the joint has been spoken of favorably by Senn and others.

Injection of antiseptic liquids into the joint cavity advised in tuberculous arthritis without secondary infection. Injections should be given at different points and no needle larger than $\frac{1}{16}$ inch in diameter used. The solution generally used consists of 2 per cent. of **creosote** and 5 per cent. of **iodoform** in equal parts of **olive oil** and **ether**. Another, employed to soften fungous masses, is made by heating 2 parts of **camphor** with 1 of **betanaphthol** until they melt and mix, and adding 15 to 20 parts of **glycerin**. The apparatus required is a 15-c.c. ($\frac{1}{2}$ ounce) syringe and an aspirating syringe holding 10 c.c. ($2\frac{1}{2}$ drams). The aspirating needle should have a lumen of $\frac{1}{16}$ inch. In simple cases with neither effusion nor fungosities, a small needle is inserted, and 5 c.c. (80 minims) of the first liquid injected. If bleeding takes place through the needle, the latter should be withdrawn and inserted elsewhere; if there is bleeding, one should wait until the next day before trying again. Ten injections are given at six-day intervals and the joint immobilized for several weeks.

Joints with effusion are first **aspirated**, avoiding manipulation of the joint to force the fluid out. After 12 injections have been given the joint is carefully dressed with a **pressure bandage**, and left for fifteen to twenty days, after which the dressing is renewed and the joint aspirated if necessary, but no fluid injected. This is repeated for three months, and always cures if properly carried out. Sore skin can always be saved by aspirating the joint at another place, and applying a firm compress. To

soften exuberant granulations in the joint 2 to 5 c.c. (32 to 80 minims) of the second liquid is injected every day until fluid collects in the joint, when it is treated as before. If each injection causes a large effusion the amount injected is halved. Calot (*Revue de therap.*, No. 17, 1906).

Injections of **formaldehyde** solution and **glycerin** a decidedly helpful measure in tuberculous arthritis. In cases with effusion the production of fluid is rapidly diminished and in favorable cases arrested. The pain and spasmodic jerking disappear, and the thickening and tenderness gradually subside. The number of injections required varies greatly, but in the average case marked improvement should follow 3 or 4. A large exploring needle should be used. The solution contains 2 per cent. formaldehyde in glycerin, and should be mixed at least twenty-four hours before use. The quantity injected is 2 drams (8 c.c.) in the ankle and 4 drams (16 c.c.) in the knee—other joints in proportion. A firm **Buck extension** is applied immediately after the operation and carried for some time after the first injections. **Morphine** may be required for intense pain, and **ice** may be applied for a day or two if there is much reaction. It is essential that fluid in the joint be **aspirated** and no air introduced with the injection. Roland Hill (*Jour. Mo. State Med. Assoc.*, Feb., 1912).

Good results obtained by injecting **phenol-camphor** (liquefied phenol, 30; camphor, 60; alcohol, 10) into various chronically inflamed joints and cold abscesses. In tuberculous joints especially the results obtained were excellent. A case of arthritis deformans of both knees was apparently cured. The amount injected is 2 to 5 c.c. (32 to 80 minims) which may have to be repeated a number of times. Occasionally a marked reaction ensues, which soon subsides. F. Pohl (*Zentralbl. f. Chir.*, May 24, 1913).

Inasmuch as the disease process is so often situated in the bone, Mac-

namara has advocated **trephining**. I have often drilled the affected bone with numerous holes about $\frac{3}{16}$ inch in diameter, and it has been of great service. Rarely pus may be found, usually not. The drilling, however, tends to stop the progress of the disease, and is worthy of more extended use than is now practised.

Forty ambulant cases of bone and joint tuberculosis, many in poor condition, treated with the **X-rays**. Filtered through a plate of aluminum 1 mm. thick, the X-rays were applied three or four times in succession at brief intervals, each time at a different side, in tuberculous joints. Three or four weeks were then allowed to elapse before the treatment was continued. In no case was more than 3 such series of exposures required to bring about healing. This treatment is not suitable for children and its use was confined to the smaller joints. Iselin (*Deut. Zeit. f. Chir.*, Bd. ciii, Hefte 3-6, 1910).

The question of operative treatment in tuberculous cases has been the cause of much difference of opinion. One fact is well settled, and that is that conservatism is more desirable in orthopedic cases than in those of general surgery. Abscesses may be opened if they pursue an acute course with considerable pain and disturbance of the patient. If they are cold, chronic, and not too large, they are best let alone, as many of them will entirely disappear. Infection is very liable to attack a discharging collection of pus, and the general health may become affected. Abscesses may be emptied with a **trocar**, washed out with **salt solution** or a weak antiseptic, and then injected with 10 per cent. **iodoform emulsion**, 1 ounce (30 c.c.) or more being used. This will probably have

to be repeated, perhaps 2 or 3 times. Sometimes the abscess keeps on discharging without any tendency to heal until death from exhaustion or general tuberculosis supervenes.

A tuberculous joint abscess should be repeatedly **aspirated**. If the process continues, and the abscess begins to point, open it, evacuate, irrigate thoroughly with 1:4000 **bichloride solution**, and sew up with 2 layers of sutures. **Incision** should be through uninvolved tissue at the side of the abscess. If a more radical measure is demanded, an **erosion** should be done, and upon the foci of disease pure **phenol**, followed by **alcohol**, applied. C. Ogilvy (N. Y. Med. Jour., Dec. 2, 1911).

In septic infection superimposed upon surgical tuberculosis, after scraping the sinuses, plugging them with gauze soaked in 5 per cent. **formalin** often gives good results. J. P. Mummery (Lancet, Jan. 6, 1912).

Abscesses complicating joint tuberculosis disappear without any treatment in at least 20 per cent. of the cases, and this percentage can be largely increased by recumbency. **Bismuth paste** has yielded most success in sinuses of tuberculous joint disease that have been discharging for one or more years; these can be cured in seven days to two months. Jacobs (Iowa Med. Jour., Oct., 1913).

Tuberculosis of the knee in adults is not fully cured without operative treatment. Primary synovial tuberculosis of the knee in adults is frequently improved or cured by inflation of the joint with **iodoform oil** unless there is bone involvement. **Excision** of the knee is the method of choice in the latter cases. Osgood and Bull (Jour. Amer. Med. Assoc., Oct. 6, 1917).

Resection of joints is to be resorted to when the suppuration is so profuse as to endanger life and the patient is of a suitable age. Resections in young children interfere so much

with growth as not to be advisable. In these patients, partial resections or erosions are to be preferred, the joint being opened and the affected tissue cut and gouged away. Operative measures become more advisable as the patient increases in age. **Amputation** is only to be resorted to as a life-saving measure, usually for profuse suppuration with entire disorganization of the joint.

Mosetig-Moorhof method used to fill up the cavity left after **resection** of a tuberculous joint in 13 cases. By doing away with the necessity for drainage, and thus the danger of secondary infection, it hastens healing. The filling was employed semi-fluid and the cavities filled up at two sittings. By this method the number of dressings is reduced to a minimum and the patient can have the benefit of country air in the interim. Vignard and Gruber (Lyon méd., Jan., 1909).

Applications of **iodine liniment** after operative treatment in tuberculosis of the joints, bones, and glands strongly recommended. After operating or scraping, the cavity is thoroughly swabbed with **iodine ointment**, using absorbent cotton twisted around the end of a probe. The liniment is applied every day. Internally, the author gives a mixture containing syrup of **iodide of iron**, 1 dram (4 c.c.), and **potassium iodide**, 5 grains (0.3 Gm.), three times a day. W. A. Tatchell (Brit. Med. Jour., Feb. 13, 1909).

Ileocolostomy performed in 8 patients suffering from advanced joint tuberculosis, with signs of intestinal autointoxication. In each case the patient gained in weight and the tuberculous lesion very definitely improved. The route of infection of the tuberculous virus is apparently the intestine. Chapple (Lancet, April 29, 1911).

Excision and stiffening of the knee-joint advocated in practically all

cases of knee-joint tuberculosis in adults. The condition of the patient with a stiff knee is not as undesirable as sometimes supposed. He suffers very little inconvenience except when dressing himself, and he is able to perform many kinds of physical labor with little difficulty. Moreover, it is possible to hold out some hope of restoring a fair range of motion by **arthroplasty** when the tuberculosis has permanently disappeared. E. W. Ryerson (*Interstate Med. Jour.*, Aug., 1911).

Of 182 cases of tuberculosis of the knee, nearly all in women, the author operated in 68—**resection** in 57, **arthrotomy** in 9, and primary **amputation** in 2. Outcome successful in 21 per cent. He uses the half-moon incision, cuts the lateral ligament if necessary, and chisels away the affected parts of the joint. The patella may be used to bridge over the resected surface. He then merely sutures the skin, leaving small tampons at the sides. In bandaging, the knee is flexed a little. The bandages should be left on five or six weeks if possible. In two to two and one-half months the patients go about on crutches. In people over 40 or 50 years old, a resection is usually contraindicated; such patients stand an amputation better. Seldowitsch (*Archiv f. klin. Chir.*, Bd. xcvi, Nu. 1, 1912).

In **excision** of the knee for tuberculous disease, nailing of the tibia to the femur greatly facilitates after-treatment and at the same time insures osseous ankylosis in good position. In excising the elbow in children, it is often necessary to combine the operation with subperiosteal **resection** of a considerable portion either of the humerus or of the bones of the forearm. H. J. Stiles (*Jour. Amer. Med. Assoc.*, Feb. 24, 1912).

The treatment recommended by the author for knee-joint tuberculosis in the adult is as follows: Allow six months with knee in plaster. If ankylosis and cure have not then resulted, operate: Transverse incision; saw

through the patella; dissect this out or leave it in, saw off about $\frac{1}{2}$ inch from the condyles of the femur, chisel off the very top of the tibial tuberosities, suture the lateral aponeuroses with catgut and the skin with silk-worm-gut, and put the leg up in extension in plaster. If there is primary union and the resisting powers are good, excellent results are then obtained. L. W. Ely (*Denver Med. Times*, May, 1912).

Of 63 **excisions** of the knee for tuberculosis, healing by first intention resulted in 53 cases. Twelve of the 63 required subsequent amputation, and, of these, 9 were under 5 years of age. In 30 patients later traced and recently examined, there was absolute ankylosis in 29 and slight movement in 1.

Among 59 excisions of the hip, mostly through **Kocher's** posteroexternal angular incision, 3 cases later required **disarticulation** of the hip for recurrence. Five patients returned with slight recurrence necessitating further operation. Forty-three patients were well and with the limb in good position when the plaster was removed. Of 40 cases traced, 12 died of general meningeal tuberculosis. The results were wholly good in 19 cases.

Of 54 **excisions** of the elbow—55 per cent. in children under 4 years of age—34 were traced; of these, 6 died of general tuberculosis. Local recurrence occurred in 8 cases. Only 1 required subsequent **amputation**, healing being usually brought about by a comparatively trivial secondary operation.

Of 29 cases of ankle tuberculosis, 21 cases operated were children between 1 and 4 years of age. Of 25 accounted for, 3 died. In 6 cases **amputation** was performed for recurrence. Stiles (*Brit. Med. Jour.*, Nov. 16, 1912).

Report of 28 **excisions** for tuberculosis of the knee-joint. In 12 no metals were used to hold the bones in apposition; in 2 silver wire was used; in 8 the aluminum wire clamps of

Goddu, and in 6 the malleable iron bone plates of Brackett. The results seemed to show that with the **plates** or **clamps** postoperative pain is less, and early union is favored. The occasional necessity of removing the clamp or plate is of little import when compared with the advantages accruing from its use. R. B. Osgood (Boston Med. and Surg. Jour., July 24, 1913).

Whereas **resection** is adapted to tuberculosis of the knee-joint, the hip-joint does best with **rest** and **relief from weight-bearing**, and the wrist-joint responds well to injections of **iodoform**.

The condition of the joint shown by the X-rays is important. The pure synovial form of disease without abscess or bony changes is best treated conservatively, while if there is extensive bony involvement operation is indicated.

A poor general condition or lung tuberculosis often improves with great rapidity after the diseased joint has been disposed of. The social condition of the patient is also of import. In a laborer, experimentation with rest, iodoform injections, or Bier hyperemia will often be impracticable, whereas by joint **resection** he can be enabled to work in two or three months. Perthes (Therap. der Gegenw., Jahrg. 53, H. 12, 1913).

Among 76 radical operations for knee-joint tuberculosis in adults in Anschutz's clinic, there were 3 **arthrectomies**, 8 primary **amputations**, 57 **resections**, and 8 secondary amputations. No case still living shows any noteworthy flexion. The Helferich operation of excision produced an average shortening of 3.7 cm.; 76.4 per cent. of the adult cases have, from resection, a useful limb. Three-fourths of the fatal cases (44) succumbed to tuberculosis elsewhere.

In **Helferich's method** 2 lateral skin incisions are made and united by an anterior transverse incision. The capsule and patella are extirpated. With a Helferich saw, an arched, thin layer of cartilage and bone is re-

moved from each joint end. The wound surfaces are covered with an iodoform mixture, and the bone ends adapted together and fixed with catgut sutures. The position of extension is maintained by a splint and bandage, first removed after about three weeks. If the position is not perfect, it is corrected under narcosis and a plaster cast applied, to be worn eight months, and after that a leather support. May (Deut. Zeit. f. Chir., Bd. cxxii, S. 171, 1913).

As a rule, patients are to be kept in bed until all evidence of acute trouble has gone and remained away for two or three months. Then the patient may be allowed to go about with some appliance to keep the joint from moving, or with a high shoe and **crutches**. These **protective appliances** are to be worn for months after all evidence of active disease has passed away. For walking cases very nice appliances which can be used for many months may be made of silicate of soda. When the patient can afford the expense an apparatus made by the instrument-maker is much preferable for all tuberculous cases. Its style will vary with the character of the case.

General treatment is to be used along with the local. Local treatment by **rest**, etc., subdues local symptoms, but for a cure one must rely on hygienic measures. The **open-air** treatment is just as applicable and necessary for the cure of a tuberculous joint as it is for an affected lung. Therefore, these patients should be given all the fresh air and **sunlight** possible. A life in a tent or shack is best. If the patient is treated in a ward or private house, the windows should be kept open day and night and only closed to exclude rain or snow. The temperature

should not be allowed to get above 60° F. (15.6° C.), even in winter, and the patient should be kept comfortable by woolen underclothing, jackets, and abundant bed covering. It is astonishing how quickly even children accustom themselves to the low temperature. The sunlight should be allowed, when practicable, to fall directly on the patient. The value of what has been called **heliotherapy** has been amply demonstrated by the valuable work of Rollier, of Leysin, Switzerland. By all means it should be carried out to the greatest possible extent. The wound or sinus, if any exists, is simply to be covered with a layer of gauze to protect it from flies, etc.

Any form of surgical tuberculosis, and at any age, can be cured by direct exposure to **sunlight**. The author's patients are exposed to the sun gradually—at first only the feet for 5 minutes 3 times a day, then the leg, then the anus, and finally the back and abdomen on the seventh day. The skin becomes red or dark brown, and this pigmentation appears to be an important factor in the cure. Phagocytosis is increased. The **dry, cold air of high altitudes** is a valuable aid to the sunlight. Plaster casts are not used, **immobilization** being secured by linen bands or jackets that may be loosened for exposure to the sun. Joint function returns almost always, while tuberculous glands become softened and absorbed. Pain is arrested early in the treatment. Tuberculous abscesses are not opened in this treatment. Rollier (*Monats. f. Kinderheilk.*, Bd. xi, Nu. 8, 1912).

After 6½ years' experience with **heliotherapy**, the writers conclude that much better results can be attained if the disease is not looked on by orthopedists and surgeons as a purely surgical one. This type of disease is a constitutional one with local manifestations and must be

treated as such until surgical interference becomes imperative. At the J. N. Adam Memorial Hospital the favorable progress of the cure is in direct proportion to the intensity of the pigmentation of the skin, which is used as an index to prognosis. The most striking local result in the treatment of joint tuberculosis by heliotherapy, and the one of greatest importance and advantage in early cases, is the preservation of motion in the affected joint. The sun acts as an agent of repair on bone tissue. The effect on sinuses and ulcers is one of marked reaction. The effect on lymph nodes is a gradual reduction of their size, and in broken down nodes their contents are often absorbed. The effect on effusions in joints, peritoneum and pleural cavity is one of absorption. Hyde and Grasso (*Amer. Rev. of Tuber.*, Apr., 1921).

The appropriate internal remedies are well known: **Codliver oil with creosote**, syrup of the **iodide of iron**, tincture of **nux vomica**, and compound **syrup of the hypophosphites** are those most commonly used. The late Dr. Goodman used a prescription composed of:

- ℞ *Bichloride of mercury* ¼₂₄ or ¼₄₈ gr. (0.0027 to 0.0013 Gm.).
Fowler's solution. 1 to 3 drops (0.06 to 0.18 c.c.).
Tincture of ferric chloride 3 to 8 drops (0.18 to 0.48 c.c.).
Syrup of orange flowers 1 dram (4 c.c.).—M

It is a very efficient combination, and acts well in many cases.

Thyroid substance indicated in sluggish cases, especially if evidences of thyroid inactivity present. Dose should be only ⅙ to ½ grain (0.01 to 0.03 Gm.) *pro die*, and patient watched for tachycardia. Lereboullet (*Paris méd.*, Nov. 16, 1912).

No case of surgical tuberculosis should be operated on without a pre-

liminary course of tuberculin. The author has 3 bottles made up with normal saline containing in each ounce $\frac{1}{1000}$, $\frac{1}{100}$, and $\frac{1}{10}$ mg. of T. R., with $\frac{1}{2}$ per cent. of phenol. He begins in a child with 1 dram (4 c.c.) of the weak solution, or $\frac{1}{8000}$ mg. by mouth, and the next week doubles the dose if there has been no fever. In out-patient service he rarely increases the dose beyond $\frac{1}{100}$ mg. As a rule, after 1 or 2 doses the appetite and color are better, and the lesion shows slight improvement. The treatment should be continued over a long time. W. S. Fenwick (Brit. Med. Jour., June 19, 1913).

Fresh air and sunlight, with careful, persistent, protective, and conservative treatment, constitute the keynote of success in the management of tuberculous joint diseases. There is no doubt that one of the most effective ways to cure a tuberculous joint is to keep it quiet. Therefore, if we ankylose the joint the process stops. On this principle Hibbs and Albee, of New York, proposed **ankylosing the joints** of the spine in Pott's disease. This has been done for a number of years and has proven a great success. We have done these operations many times and unhesitatingly recommend them. Contrary to what would be expected, the children stand the operation well and almost invariably show an immediate local and general improvement. Personally, I keep a plaster cast on for six to eight weeks after the operation, follow with a light brace for six months, and then discard everything.

In **excision** of the knee the end of the femur is sawed convexly by the author, that of the tibia concavely. He advocates cleansing of the joint cavity and division of the flexor tendons in children. Ligation of the vessels is usually unnecessary. If pos-

sible, no drainage should be used. Merckens (Zentralbl. f. Chir., Bd. xxxix, S. 949, 1912).

The treatment by **exposure to sunlight in clear and cold air**, if the patient's state does not contraindicate it, gives the most positive results in this disease. In 80 per cent. of closed bone lesions heliotherapy, however, does not stop the tubercular process and in 20 per cent. of the cases it aggravates it. This type calls for an **open operation**. Heliotherapy cures open bone lesions and closed synovial lesions, but takes time. Perera (Prog. de los clin., Madrid, vi, 57, 1918).

LOOSE BODIES IN JOINTS.

SYMPTOMS.—The symptoms of this affection are marked, and are due to interference with the function of the joint. The knee is the joint most often affected. The patient, while walking, is apt to experience a severe pain in the joint and may either fall or else hold the joint stiff. It may become locked. In some cases the patient can so manipulate the part as to free the loose body, walking then again becoming possible. These sudden attacks of disability are followed by a swelling of the joint and all the symptoms of an acute synovitis. The repeated attacks supervening on the original injury are apt to keep the joint constantly in a state of low chronic inflammation which is more or less disabling.

Beside the pain and stiffness which may be produced, the patient has a continual sense of distrust, which causes him to avoid using the joint freely and thus interferes with walking. In many cases there is nothing apparently wrong with the joint until the moment of pinching or jamming of the loose body while the joint is in motion. These patients

are usually skillful in finding and localizing the loose body, but not always. Often it disappears on the slightest movement, not to be discovered until it again intrudes itself upon the patient's notice at some inopportune moment.

Loose bodies in joints are usually the result of injury or disease. Many are due to mere masses of fibrin and show little or no structure. Whether simple effused blood can become so firm and compacted as to form loose bodies is questionable; ordinarily such effused blood is absorbed. It is quite probable, however, that some of the milder forms of foreign bodies are of this character. The synovial membrane is, however, a prolific source. Usually as the result of injury, the synovial fringes become inflamed, condensed, and finally separated, leaving the detached body floating free in the joint. This is shown to be the case in that some foreign bodies are covered with synovial membrane. They are not only fibrinous in character, but also cartilaginous. Cartilage cells are normally found in the synovial fringes, and it is easy to see how an injury could start up sufficient action to form an appreciable lump. Sometimes the bodies are found with a pedicle, by which they are still attached to the synovial fringes. Some of the cartilages may be so severely injured as to be partially or wholly detached or torn off. The fragment then floats free in the joint, or if only partially detached becomes parted later on.

Disturbance of the villi in the knee often appears a long time after injury. The villi enlarge and intrude between the joint surfaces. Sometimes they are congenitally large, and cause

trouble from childhood on, much increased by injury. Ordinarily they are not sensitive, but they become so when inflamed. In some cases they seem to be remains of a torn ligament. Occasionally folds and adhesions in the capsule are left after the injury and the villi are caught in the pockets thus formed. Where the enlarged bodies cannot be felt from the outside, the diagnosis is probable if there is constant tenderness at one point in the capsule. Impaction is more common with enlarged villi than with loose bodies. The treatment is **excision**, which is most satisfactory in all cases.

Loose bodies often result from the tearing off of small pieces of bone by the crucial ligaments, but sometimes by necrosis following embolism of an artery in the articular surface. In most cases the X-rays will reveal the free body, and may show a corresponding defect in the cartilage of the femur. When possible, the body should be removed through a very small incision under local anesthesia. The finger should not be inserted into the joint. König (*Archiv f. klin. Chir.*, Bd. lxxxi, 2, 1907).

Many cases of functional knee symptoms are due to reflex atrophy of the quadriceps extensor muscle resulting from injury. The term relaxed knee-joint should be reserved for such cases. The injury may be so slight that its etiological relation is overlooked. The atrophy cannot be explained as due to inactivity. Recovery is so protracted in some cases as to suggest serious injury to the central nervous system. The symptoms are very similar to those of locking from movable cartilage or of villous growth projections into the joint. The latter, the author believes, are usually secondary to this relaxed condition. The treatment consists in **massage, exercise, and electrical stimulation** until the muscle has resumed its normal tone. Freiberg (*Amer. Jour. Med. Sci.*, May, 1908).

Excrescences of fatty synovial fringes in the knee-joint, first de-

scribed by Hoffa, spring from the ligamenta alaria and mucosa, undergo inflammatory hyperplasia, and become caught between the ends of the bone, producing severe symptoms. The causative synovitis may be due to trauma or disease. Almost always a chronic swelling of the joint, and especially of the fatty masses at the sides of the ligamentum patellæ, precedes the severe symptoms. Of course, isolated lipomas and sarcomas have also been reported. Rammstedt (*Archiv f. klin. Chir.*, Bd. lxxxix, S. 173, 1909).

The chief diagnostic points in cases of hypertrophy of the synovial fringes of the knee are the long duration of the trouble, the remarkable contrast between the relative freedom of movement and the changes in the shape of the joint; the intensity of the pains when the knee is used, compared with their rapid subsidence during repose, and the integrity of the bones and cartilages. Recovery without impairment of function generally occurs as soon as the excrescences have been removed. Arborescent lipoma, villous polyarthritis, and Hoffa's disease are merely three forms of a single lesion, which may be called chronic polyform fibroadipose synovitis. Lefèvre and Dubourg (*Archives gén. de chir.*, May, 1913).

Though almost always confined to the knee, the so-called loose cartilages are occasionally met with in the elbow, and rarely in some other joints. C. D. Brooks (*Jour. Mich. State Med. Soc.*, June, 1913).

The writer observed a case of loose cartilage in the temporomaxillary joint. The patient's chief complaint was inability to close the mouth so that the teeth would come together, causing great difficulty in masticating food. The condition followed a difficult effort at mastication 8 months before. Operation was successful.

Behan (*Ann. of Surg.*, lxxvii, 536, 1918).

The semilunar cartilages are particularly liable to be the seat of injuries. Sometimes a piece of bone

is detached along with the cartilage, as occurred in a patient of mine. These bodies not infrequently contain calcareous or true bony matter. In osteoarthritis or arthritis deformans loose bodies are frequent and may exist in great numbers. This is only what would be expected of a disease in which the various cartilag-



Loose bodies in the knee-joint. (Schüller.)

inous and fibrous structures are so extensively affected.

There is usually a clear history of injury in these cases, to which the origin of the trouble can be traced.

Among 190 knee-joints with symptoms of derangement opened, 30 showed thickening and irregularity of the structures about the ligamenta alaria; 9, polypoid fringes; 10, no lesions. In 2 of the latter it was found on subsequent operation that the symptoms were due to the be-

havior of a tendon over an osteoma, and in 1 to a small fracture irregularity on the femoral condyle. In 8 cases early signs of hypertrophic arthritis were present; in 9, isolated loose bodies, and, in 4, loose bodies attached by a pedicle. The remainder presented villous arthritis along the articular margin, lipoma arborescens, and fibrous thickenings around the attachment of the anterior crucial ligament.

The most common injury to the knee-joint is a sprain or rupture of the internal lateral ligament; next to this, injury to the inner cartilage. Jones (*Annals of Surg.*, Dec., 1909).

Dislocation of the semilunar cartilage involves the internal cartilage more often than the external. The peripheral attachments of the cartilage may be torn, the anterior and posterior remaining intact, or the anterior cornu may be detached. Transverse fissures of the cartilage may occur, the fragments being drawn inward or longitudinal fissures of the middle two-thirds of the cartilage, the internal fragment deviating inward. There may be an associated subluxation of the tibia. Gorse (*Archives gén. d. chir.*, vol. vi, p. 244, 1910).

The femoral condyles are firmly fixed in the hollows of the semilunar cartilages by the weight of the body, atmospheric pressure, and muscular tone. So strong is this union that in excessive rotation at the knee the semilunars tear their capsular anchors before parting company with the femoral condyles, with which they have only indirect tissue connections. The pain of "slipping of a cartilage" is due to a pull upon and laceration of the capsular attachments and not to any squeezing of a probably insensitive fibrocartilage. Digby (*Lancet*, Jan. 15, 1910).

Even a very minute foreign body in a joint can produce trouble by causing reflex muscular contraction and thus arresting the movements. When a semilunar cartilage has been

recently injured, there is generally effusion of blood with immobility and later circumscribed tenderness. The cartilage is movable. **Rest in bed** and **prevention of strain on the knee** will favor healing of the cartilage in its normal place. If the injury is of long standing an **operation** is necessary. If the cartilage is much out of shape it must be removed; the results of this are always dubious. If it has kept its normal shape it can be sutured in place. The author never removes one unless absolutely necessary and replaces it in its normal position, cutting the ligaments if necessary to obtain better access. Excellent results in 23 cases. M. Katzenstein (*Archiv f. klin. Chir.*, Bd. xcvi, Nu. 4, 1912).

TREATMENT.—By keeping the joint quiet in one position with the aid of **splints** or **apparatus** for a long time the loosened parts may become fixed or cease to give trouble. Usually a joint can be moved forward and backward without trouble, but a slight twist renews the active symptoms. In such cases the **Shaffer brace** for the knee, which allows flexion, but prevents rotation, often gives complete relief. In injuries of the semilunar cartilages where relief cannot be obtained from the brace the **open operation** should be done and the loose end of the cartilage removed.

The treatment of "caught fringes" in the knee may be conservative if they give only moderate disturbance. Gradual return to normal generally follows **massage**, **heat** in the form of **sand baths** or **hot air**, **elastic compression** by bandages, and guarded use of the joint with **apparatus**. Operation is justified in cases with limitation of motion and severe pain associated with locking of the joint. The latter should be opened freely by a curved **incision**. the hypertrophic masses seized with forceps

and excised with suitable scissors. The hemorrhage is slight. Drainage is unnecessary. If bloody serum should form it may be removed by puncture at the first change of dressing. In twelve to fourteen days after healing, **massage, hot air, movements, and compression bandages** should be employed. Rammstedt (Archiv f. klin. Chir., Bd. lxxxix, S. 173, 1909).

When the patient is seen directly after injury of a semilunar cartilage every care should be taken to **replace** the latter by **manipulation**. **Rest** in an extended position must then be insisted upon until the swelling has subsided, **massage** being employed throughout. D'Arcy Power (Brit. Med. Jour., Jan. 14, 1911).

Where the internal semilunar cartilage is displaced one should endeavor to **replace** it by forcibly separating the opposing surfaces of the internal condyle and of the corresponding surface of the tibia by flexing the knee, and at the same time abducting it, using the external condylar joint as a fulcrum. If one is unsuccessful in freeing the displaced cartilage, the sooner it is removed by an **incision** into the joint the better, as there is always difficulty in extending the knee completely after it has been kept flexed for any length of time. Apart from this, the best treatment for a damaged fibrocartilage is early, efficient **massage** and **exercise**. As long as the fibrocartilage is painful and swollen the patient should retain the limb in a position of extension when he gets about. Any synovial effusion should be removed and the muscles restored to their normal bulk and function as soon as possible, since impaired function means liability to recurrence of the trouble. The patient should be instructed to avoid the attitude of flexion of the knee and abduction of the foot in which the cartilage was injured. The inner margins of the feet should be kept parallel during locomotion. Lane (Brit. Med. Jour., March 11, 1911).

In 5 cases of movable bodies in the knee joint the writers removed these bodies by **arthrotomy** and **immediate locomotion**. Such a procedure had already been advocated before the war by Willems in joints evacuated by puncture, and since applied also in a series of men with missiles lodged in the joint or even with intra-articular fractures of the knee, excellent results following. For movable bodies the writers make an internal or external incision in the joint, according to the situation of the movable body. The latter having been removed, the incision is closed in three layers, synovial membrane, capsule, and skin. Only a small, loose dressing is applied, to obviate restriction of joint movements. As soon as the patient awakens from the anesthesia, active mobilization is commenced, the patient being required to raise the extended limb and perform a series of flexor and extensor movements, in as wide a range as possible. The same exercise is continued almost without interruption. Next day, and sometimes even on the same day, the movements in beds are replaced by walking without any support. The patient is at first fearsome and hesitates to flex the knee in walking, but soon becomes convinced that he can walk with but little pain, bears more weight on the limb and gradually flexes it. Willems and De Caestecker (Presse méd., Dec. 17, 1917).

In the presence of loose bodies traceable to injury **removal** is, if possible, indicated at once. The procedure which I have found most satisfactory is as follows: The surgeon feels for the loose body, and when found crowds it into some corner and holds it firmly there with his thumb. The pressure being still kept up, the patient is etherized and an incision made with the other hand down to the capsule of the joint directly over the loose body. A pin is then thrust into it and an incision

made directly through the capsule and the body turned out. Special suturing of the capsule is not necessary; two or three deep interrupted sutures to close the wound are all that is essential. If pressure is relaxed before the pin is thrust into the loose body, it may slip away into the joint and be lost. The loose bodies cannot be made to appear at will. The favorite places for them are on each side of the patella, especially the outer side and down below and to its inner side.

In the operative treatment of hypertrophied synovial fringes interfering with motion in the knee-joint, the author merely cuts down to the capsule on each side; retracts it, pulling the fringes out of the joint; takes up a fold of the capsule, secures it with sutures, and cuts it off inside of a specially devised clamp. The cut edges are finally sewed together with a fine suture, which buries the exposed synovial border. The skin incision is closed and the leg kept in an extension splint about a week. Motion is not restricted and the joint is practically normal a few days after removal of the splint. The advantages are less danger than from an intracapsular operation, better assurance of complete recovery, and avoidance of long after-treatment. E. G. Abbott (Jour. Amer. Med. Assoc., May 23, 1908).

Several cases of "joint mice" and foreign bodies in the posterior portion of the knee-joint met with. Their **removal** by any of the classical, quickly repairing incisions into the knee-joint is difficult. The authors therefore make an incision in the popliteal space 10 cm. long, centering over the joint line and slightly to the inside of the median line. The vessels are retracted outward and the incision is carried down to the posterior ligament by blunt dissection. The position of the mouse or foreign body is detected by palpation. Upon

incision through the posterior ligament and capsule the bodies usually present, owing to the tension of the capsule. Four cases of successful removal reported. G. E. Brackett and R. B. Osgood (Boston Med. and Surg. Jour., Dec. 28, 1911).

The writer has had 51 cases of movable bodies involving the elbow and only 18 affecting the knee-joint. The elbow cases were mostly in the 14 to 18 age group or had originated during those years. Early diagnosis is important, since by **early removal** of the bodies the development of arthritis deformans is prevented. If arthritis deformans is already present and is not too far advanced, recovery is brought about often by the mere removal of these bodies. During the operation the point of origin of the loose bodies should be looked into and the site cleared up lest new movable bodies be continually formed. Kappis (Deut. med. Woch., Oct. 14, 1920).

In cases that will not submit to operation, some device may be utilized to alleviate the affliction. A simple **elastic knee-cap** may afford some relief. Sometimes the body only causes trouble when either excessive flexion or longitudinal rotation of the bones of the joint takes place; where this is so, dressings or apparatus that limit flexion and to a great extent prevent rotation may be applied. When the loose bodies are the result of osteoarthritis they are apt to be so numerous as to preclude the giving of relief by an operation for removal.

ANKYLOSIS.

When from injury or disease a joint loses its function and becomes stiff, it is said to be ankylosed. Ankylosis may be either *bony* or *fibrous*. The former has been called *true* and the latter *false* ankylosis. In bony ankylosis the bones entering

into the formation of the joint have become united by bony tissue. In fibrous ankylosis either the articular ends of the bones are united by fibrous bands going directly from one to the other or else motion is restricted by changes in and around the capsule of the joint. The name is not applied to loss of motion due to changes in structures unconnected with the joint, such as contracted tendons or muscles, or cicatrices from burns. All inflammations of joints, from whatever cause, if violent enough and long continued, are liable to cause ankylosis. Such affections as destroy the articular surfaces of the joint are very likely to be followed by ankylosis. Suppuration oftentimes, but not always, results in a more or less complete loss of motion. Serious joint disease almost always results in some loss of movement of the joint, but a certain slight amount may remain; hence one speaks of restricted motion, or one may perhaps be allowed to use the term "incomplete ankylosis" to express this condition.

To diagnose ankylosis one must exclude the rigidity caused by muscular contraction; therefore in doubtful cases the examination should be made under an anesthetic. The production of pain by attempted motion is good evidence that complete ankylosis is not present, because it is the movement of the parts that causes the pain. An approximate idea of the extent of the stiffness may be obtained from the clinical history of the case as to whether the disease has been violent in character and long in duration.

TREATMENT.—This is preventive and curative. Attempts to pre-

vent the occurrence of ankylosis in joints that are the subject of disease by means of passive motion are usually not only futile, but positively harmful.

Any brusque, violent or extensive movements only increase the inflammation and activity of the disease already present. The joint has enough to do to attend to the original disease without having to contend with the added violence of misapplied surgical energy. The amount of pain experienced is a good guide to the amount of motion to be practised; if it is severe or long continued this is evidence that the movements have been too extensive. It is best to wait until the active evidences of disease have disappeared before attempting movements. In tuberculous and other diseases the attempt to restore motion is apt to relight the original trouble; therefore it is well to have as long an interval intervene as possible.

In acute joint affections, to prevent ankylosis, **extension** should be put on. Tension must be relieved not by incision, as that leads to obliteration of the cavity, but by **aspiration**. After this there should be injected into the joint a 2 per cent. **solution of formalin in glycerin**. J. B. Murphy (Med. Rec., Oct. 29, 1910).

The predisposing age for ankylosis of the jaw is from 1 to 10 years. Trauma is often the primary cause, also scarlet fever, otitis media, dento-alveolar abscesses and gonorrhea. The cartilage is gradually transformed into a vascular or fibrous or fibro-osseous tissue; the joint cavity is traversed by dense fibrous bands; which may be converted into a mass of spongy bone. The best treatment consists in **removing a section from the condyle, interposing fascia** between the segments. Lyons (Jour. Amer. Med. Assoc., Jan. 20, 1917).

Restoration of motion is only possible in cases of fibrous, not bony, ankylosis, and when the disease has not been too extensive. The utmost that can be hoped for in many cases is the placing of the limb in a more useful position. When it is desired to restore motion in a stiff joint, the patient should be anesthetized and the joint first flexed and then extended; this should be repeated until as much motion as possible has been secured. The part is then kept at **rest** and **ice-bags** applied until the resultant inflammation has subsided; next mild **passive motion** is to be employed for some time until it is seen whether anything has been gained. If not, then it is useless to repeat the procedure, for if no motion has been gained some will probably have been lost, and with each succeeding effort the condition of the joint is worse. Care must be taken not to fracture the bones in making the necessary manipulations. The bones, from long-continued disease, are apt to be somewhat atrophied and not so strong as normally. If it is desired to increase the extension of a joint, a good plan is to apply some sort of a **splint** or **apparatus** that holds the part in its most extended position and then remove it daily and apply **passive motion**, again replacing the apparatus. An apparatus producing gradual pressure, such as the **Strohmeyer screw**, is often serviceable when it can be applied.

Ionization found superior to massage and other measures for the resolution of ankyloses. A 2 per cent. solution of **sodium chloride** or **sodium salicylate** is used and the best results have been obtained with electrodes covering a space of 100 or 200 sq. cm., a current ranging from 50 to

80 milliamperes, and sitting lasting one-half to one hour. The ankylosis seems most readily influenced when of traumatic origin; next come the postinfectious ankyloses, and last the post-rheumatic. The cathode is applied to the part to be treated. Desfosses (*Presse méd.*, vol. xv, No. 23, 1907).

Fibrolysin used with success in treatment of deformities and contractions due to chronic joint conditions. The author injects 2.3 c.c. (37 minims) twice a week subcutaneously in the arm, leg, or loins. It is not advisable to inject it near a joint. As a rule, no improvement is apparent until 4 or 5 injections have been given, and it is necessary to give 30 to 40 altogether. G. A. Bannatyne (*Lancet*, Jan. 23, 1909).

Fibrolysin used with benefit in joints ankylosed as result of rheumatic affections. Single dose used was 2.3 c.c. (37 minims) subcutaneously, sometimes more; largest total amount given was 117.3 c.c. (4 ounces). Untoward effects: sometimes sensation of fatigue on day of injection, and occasionally slight local inflammatory reaction, which disappeared with moist dressings. Best results where ankylosis due to extra-articular connective tissue; less improvement in presence of pus and in gonorrheal cases. Used in conjunction with hygienic and dietetic measures, **warm sulphur baths**, and later **active** and **passive movements**. K. Knotz (*Med. Klinik*, July 25, 1909).

Good results obtained in ankylosis of the knee by **immobilizing** the joint under deep anesthesia, next immobilizing it in extreme flexion for twenty-four hours, then suspending it in a sling in the daytime from a high crossbar so that the leg hangs free, its weight helping to correct the ankylosis. At night the **suspending sling** is removed. Muller (*Münch. med. Woch.*, Dec., 1910).

Gradual strong **flexion** or **extension** by means of **rubber bandages** of the

ordinary 2½-inch kind, or of double weight, recommended for mobilizing joints. The manner of application should be such that the contraction of the bandage takes place in the line of normal movement. The method gives an even, confidence-forming tension and overcomes the voluntary and spasmodic contraction of the guarding, protecting muscles. Slight pain and discomfort may be permitted on condition that the joint is not tender on the following day. The applications should be made at first every second day, then daily. Joints with false or fibrous ankylosis in which there is no danger of activating a quiescent infection should be broken up under anesthesia, and the rubber-bandage method begun the second day after. A. C. Strachauer (Jour. Amer. Med. Assoc., March 11, 1911).

Following paste used to interpose between the denuded surfaces after breaking up ankyloses: **Yellow wax**, 1 part; **mutton tallow** and **castor oil**, of each, 2 parts; with 15 grains (1 Gm.) to the ounce (30 Gm.), by weight, of **bismuth subnitrate**. This wax melts at 140° F. (60° C.), is semisolid, and begins to congeal at 128° F. (53° C.). It should be drawn up in the syringe again and again to get a uniform suspension of the bismuth, and for cooling purposes. The bismuth is for the purpose of taking X-ray pictures. The mixture is well tolerated. Voluntary active motion is soon possible, as it is practically painless, and the range of motion, if sufficient fibrous and osseous tissue has been removed, should approximate normal limits as soon as the involuntary muscular rigidity from the patient's timidity disappears.

Lanolin, 2 parts, and **wax**, 1 part, form a smoother articular wax than when combined with other substances and less likely to form hard, lumpy masses under the skin incision. Only enough wax should be used to separate the eroded surfaces. Taylor (Surg., Gynec., and Obstet., April, 1912).

Seven cases of ankylosis in which injection of a mixture of **yellow wax**, 1 part, and **lanolin**, 5 parts, melting at about 130° F. (54.4° C.) yielded gratifying results. Taylor (N. Y. Med. Jour., May 31, 1913).

The writer reports a series of 6 cases of fibrous ankylosis following tuberculous arthritis of the knee, treated with **radium** with encouraging results. Each case gave a positive von Pirquet reaction and a negative Wassermann test. J. J. Nutt (Am. Jour. Orthop. Surg., Feb., 1917).

Stiffness arising from injuries such as fractures is usually due to their involving the joint and from misplacement of the fragments directly interfering with motion, or else to pouring out of callus and non-bony effusion from the injured parts. Ankylosis from the former cause is to be prevented by a more correct **apposition of the fragments** before they have had time to become fixed in their abnormal position. Ankylosis from the latter cause is to be avoided by **gentle and persistent passive motion**.

Bony ankylosis should be treated either with a view to bettering the position of the part or to the formation of a false joint. If the former result is aimed at, **osteotomy** is of service, especially in cases of hip disease, in which the neck of the femur is divided or a subtrochanteric osteotomy performed; also, to remedy a bad position of the foot. In the knee the amount of deformity is usually so great as to require **resection**; here osteotomy is not applicable.

Report of cases of restoration of joint function by **transplantation of part of a joint** from an amputated limb. The author has transplanted an entire knee-joint in a child, with excellent results. Lexer (Med. Klinik, May 31, 1908).

Three cases of faulty ankylosis of the hip-joint corrected by sawing the femur from the top of the trochanter obliquely to a point low down on the other side. The upper segment was slipped up on the shaft, thus lengthening the limb. The contact between fragments is favored by the traction of the muscles. Extension is to be applied until the parts have healed. By flexing the trunk on the thigh and rotation of the femur on the pelvis after the consolidation has reached a certain point, one can obtain some loosening of the ankylosis. E. Quénu and P. Mathieu (*Revue de chir.*, July, 1910).

Adhesion of the patella to the femur can be prevented by transferring the bursa between the patella and the skin to the space between the patella and the femur. This was done in 2 cases and the result was excellent. Schanz (*Zentralbl. f. Chir.*, Feb. 18, 1911).

The author does not operate for ankylosis of the knee unless the patient is young and strong, with the extensor muscles still partially active, and the patient promises co-operation and can spare the time for after-treatment. He has applied the principle of interposing a pedunculated flap of soft tissue to 3 young women, a girl of 12, 7 young men, and 1 boy of 11. The ankylosis was of tuberculous or gonorrheal origin in 2 cases each. In 3 cases a free **autoflap of soft tissue** was interposed; in the others a large flap from the fascia lata above was drawn down. In 8 cases the outcome was very satisfactory. Payr (*Archiv f. klin. Chir.*, Bd. xcix, Nu. 3, 1912).

Covering of both joint surfaces with **fetal amnion** and fixation of this membrane by sutures to the periosteum advocated in the operative mobilization of the knee-joint after ankylosis. Case of a 20-year-old girl, operated upon for gonorrheic ankylosis of the knee, with the result that she was able to take long walks, as well as kneel and rise, without assist-

ance. Schmerz (*Beiträge z. klin. Chir.*, Bd. lxxvi, H. 2, 1912).

Joint transplantation is indicated in young subjects with good general physical condition and presenting ankylosis of the knee in a faulty position, or tumors involving this joint, recurrence of which is not expected, and provided the condition of the related muscles is good, or, if not, susceptible of improvement. In the case of the hip, the indications are less positive, though good results have already been obtained by transplantation of this joint. Heretofore the results have been best where the joints have been transplanted without synovial sac or capsules; these are spontaneously reconstituted later. Ducuing (*Revue de chir.*, Sept., 1912).

In the shoulder-joint ankylosis is not so disabling as in other joints, and usually no operation is advisable. If, however, motion is desired, it can be obtained by **resection** of the head of the bone. In the case of the elbow good results are obtained by resection of the joint; good and serviceable motion is often obtained. When too little motion results, it is usually because too little bone has been removed. As healing progresses, what at first looks like a flail joint becomes a very useful one. The **insertion of fatty and fascial flaps** between the bones after the **method of Murphy** is very successful in the elbow-joint, but less so in the shoulder and hip, and least in the knee.

Bony ankylosis of the elbow cured by chiseling the joint to its original shape and then covering the cut surfaces with a **flap of periosteum** taken from the patient's own tibia. Four other cases similarly treated. Anterior surface of tibia seems to be the best location for taking the flap of periosteum, care being observed to retain the osteoblast layer intact. Joint to be immobilized in a cast for

several weeks. Hofmann (Beiträge z. klin. Chir., Sept., 1908).

Interposition of muscle, fascia, or any non-absorbable material into a joint cannot form the ideal method for the production of mobility. The anatomical structure of the joint is often materially interfered with when any bulky substance sufficient to cover the entire joint, as a muscle, is interposed. In a majority of cases the interposition of a living tissue is followed by constant pain, due to pressure upon its nerve endings. Further, the motion is generally unnatural in character and the joint often unstable.

The author used a **membrane from the pig bladder**, chemicized so as to remain intact about forty days. Good results in 8 cases. W. S. Baer (Bull. Johns Hopkins Hosp., Sept., 1909).

Case of ankylosis of the hip-joint in which excision of part of the joint and interposition of a **flap of fat** and a thin layer of **muscle** fastened with silk sutures restored the cripple to active life. Meyer (Deut. med. Woch., Nov. 4, 1909).

The methods of treating stiff joints are principally the simple separation of the adherent joint ends through **arthrolysis** or **osteoarthrotomy**; **resection**; the **method of Kocher**, which consists in the arthrolysis or resection of the joint ends, placing them in a position of luxation, and replacing them fourteen days later to prevent reunion; the **interposition** after arthrolysis or resection of **dead inorganic** or **organic material**; the **transplantation of living tissue** or a **pedicle flap** from the neighboring soft parts; the **creation of a pseudoarthrosis** in the neighborhood of the ankylosis, or the **transplantation of the entire joint**.

For simple defects in cartilage, **transplantation of periosteum** and **perichondrium** serves the purpose; in all other cases it is best to interpose a **pedicled flap of muscle, fat, fascia, tendon sheath, or synovial mem-**

brane. The flap of tissue should be securely fastened over the bone ends. The dressing after operation should make firm compression, to prevent collection of blood. The author almost always employs **extension** for several days and a **plaster bandage** is used only when there is danger of dislocation, as in the hip. When necessary, blood or wound serum is **aspirated** after two or three days.

In the after-treatment the skin should be kept movable over the underlying bone, to prevent adhesion of the scar. Light **passive movement** should be executed daily. After healing of the skin the position of the joint should be frequently changed. **Fibrolysin** injections every other day are useful. Brisk passive movements, especially under ether, are harmful. Where muscles are too weak, they can sometimes be strengthened by **tendon transplantation**. Of 30 cases operated for ankylosis by the author, there were 9 satisfactory and lasting results. Payr (Münch. med. Woch., Sept. 13, 1910).

Brisement forcé is useful in cases of only synovial adhesions; in true bony or fibrous union it is apt to do harm. **Arthroplasty** is very valuable in cases of bony or fibrous ankylosis of the jaw, shoulder, elbow, hip, and knee. Either muscle, or fascia with fatty tissue, should constitute the interposed flap. Enough bone should always be removed to allow very free mobility; also enough of synovial membrane, capsule, and ligaments. In arthroplasty at the hip, the lower extremity should be put up in **extreme abduction** with **Buck's extension**. In general, early **passive motion, massage, hot-air baths**, and frequently **forcible motion** under anesthesia to break up recent adhesions are of value. The author reports a case of elbow ankylosis in which a flap 5 inches long and $2\frac{1}{4}$ inches wide was dissected from the triceps region, with its base close to the elbow, turned down into the joint, and sutured with catgut to the margin of the periosteum over the humerus and

ulna. The olecranon, previously divided to give a good exposure, was then attached to the ulnar shaft by a silver-wire suture, and the wound closed without drainage. The arm was put up at 60 degrees extension in plaster of Paris. A good ultimate result was obtained. Wiener (*Amer. Jour. of Surg.*, Sept., 1911).

Case of complete ankylosis of the elbow due to an old articular rheumatism. After dividing the ankylosis and trimming the ends of the bones to form as nearly as possible the normal contours the author took a portion of the *fascia lata* to cover the lower end of the humerus. After two months the patient had 50 degrees of spontaneous motion and was well satisfied. D. Pupovac (*Wiener klin. Woch.*, April 4, 1912).

Discussion of 62 **arthroplasties** for bony ankylosis. Perfectly movable, normally functioning joints can be and have been thus reproduced. By the author's method a new synovialoid membrane is produced, with fluid resembling synovial, and lining cells identical with those in hygromata. These joints are painless once repair is complete and are not subject to the hematogenous metastatic arthritides of normal joints. A fibrocartilage-like structure develops on the end of the bone, and the latitude of motion increases with time up to the full anatomical limitations, in the uncomplicated cases. J. B. Murphy (*Annals of Surg.*, May, 1913).

Ankylosis of the spine has been treated by **forcible straightening of the kyphosis** by non-operative means, but the true value of this is as yet undetermined. In some cases new bone has not formed to fill up the resultant gap, and consequently relapses are very apt to occur. Straightening in several sittings is better than to completely straighten at one. The articulation of the lower jaw becomes ankylosed at times, and should be treated by liberal **resection**

of bone, preferably done from within the mouth.

The treatment of ankylosis of the finger-joints is governed by the occupation of the individual. In people who have manual work to do, *e.g.*, machinists, carpenters, etc., a stiff finger is so much in the way and so often becomes injured that it is sometimes advisable to amputate it. The patient, however, should be the one to decide as to the advisability of **amputation**, and it is best to wait until he finds the affected finger useless.

Immobility or stiffness of the shoulder is becoming more common since the war began. The author describes a method which he has found satisfactory in the treatment of such cases. It should not be used, however, when the immobility is associated with tuberculous or adjacent arterial trouble. After the treatment has been well established by nurse or surgeon it can be carried on by the patient at his own home. The apparatus first used consists of a wheel, 4 feet in diameter, attached to a table, the movement to be produced by hand, pedal, or otherwise. With the patient strapped to a chair the shoulders are manipulated with the apparatus, the speed and circle of circumduction being gradually increased; 60 revolutions is a desirable rate. In 2 weeks, with treatment twice a day, the patient is usually ready for the second stage of the treatment, which is carried out by means of a skipping rope, 14 feet in length, fastened to a tree or wall at a level with the patient's shoulder. A small weight is attached to the center of the rope, and the patient with his scapula fixed by a belt around the shoulder and chest, swings the rope. Progress is certain when the patient once becomes accustomed to this exercise. W. Johnson-Smyth (*Pract.*, xcvi, 575, 1917).

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JOINTS, SURGICAL DISEASES OF (CONTINUED).

HIP-JOINT DISEASE.

DEFINITION.—What is usually known as “hip-joint disease” is tuberculosis of the hip-joint; but tuberculosis by no means includes all the diseases which may affect the hip. The hip may be affected by tuberculosis, by syphilis, by rheumatism, and by a variety of acute infectious processes subsequent to the occurrence of some acute infectious disease in other parts of the body, or may be the seat of a simple synovitis caused solely by trauma. A synovitis of the hip is usually associated with osteitis, but a synovitis may exist independent of osteitis and subside without the occurrence of any involvement of the bones.

The hip-joint is also the seat of arthritis deformans and Charcot's disease, though the latter is rare, and occasionally loose bodies are found in it. Malignant tumors also may affect the hip.

Functional affections of the joint are usually traumatic neuroses, but may be considered here.

The writer recalls the obscure affection of the hip joint of Legg and Calvé, which he proposes to call *malum coxae Calvé-Legg-Perthes*. He protests against calling it osteochondritis, as there is no inflammation. The special characteristic is a flattening of the femoral head in young subjects, weight bearing crushing it when nutritional disturbance has interfered with its proper development. Perthes persists in advocating the name *osteochondritis deformans juvenilis*. He cites a number of instances of its bilateral development. Several have observed a familial tendency. H. Sundt (*Zentralbl. f. Chir.*, May 29, 1920).

SYMPTOMS.—The symptoms of *inflammation* in the hip vary somewhat, according to the character of the inflammation present. If the hip is the seat of an acute synovitis, pain will be felt in the hip itself, which will be intensified by movement of the joint or by pressure over the neck of the femur at a point between the great trochanter and the crest of the ilium.

The writer has observed 5 cases of a hip-joint disease characterized by absence of severe local symptoms, though it entailed extensive destruction of the joint. A little pain and slight limping were the maximum of the disturbance. This form of hip-joint disease develops insidiously and is liable to be confounded with *coxa vara*. Kirmisson (*Bull. de l'Acad. de Méd.*, July 12, 1910).

An attack of pain in the hip-joint should lead us to suspect tuberculosis when it is accompanied by a clearly perceptible atrophy of the muscles of the hip and thigh, when the leg is either lengthened or shortened, when there is a swelling of the joint and of the glands in front of it and on the psoas, and when the disease has been preceded by a change in the physical and psychic condition of the child. When the sciatic and crural nerves are tender, both trochanters are abnormally high, there is no atrophy of the muscles, the joint itself is painless, and there is contracture of the flexor and abductor muscles, with concentric limitation of their excursions, suspicion should be directed toward an irritation of the joint produced by static conditions. When the hip exhibits a sudden and painful flexion contracture with abduction or slight adduction; when the joint is slightly swollen and tender, its mobility somewhat impaired, while the glands are not affected and there is no muscular atrophy, the possibility of a benign, ephemeral coxitis must be taken into account. F. R. von Fried-

laender (N. Y. Med. Jour., from Wiener klin. Woch., June 19, 1913).

Among the earliest symptoms noted in the Mayo Clinic were muscle-spasm, limping, pain and atrophy. Pain is often referred to the knee-joint. Night cries are not in themselves diagnostic. H. W. Meyerding (Minn. Med., Aug., 1918).

The position of the limb is very characteristic. The thigh is flexed upon the abdomen, abducted, the toes everted, and the entire limb rotated outward. This position allows the capsule to contain the largest amount of fluid, and, in consequence, is the position of ease which the joint naturally assumes when overdistedended. In cases of this sort, also, there is usually a distinct history of a traumatism immediately preceding the occurrence of pain. These cases are also extremely sensitive to any sort of motion. In standing, the patient bears all the weight of the body upon the sound side, and in consequence of the position of the affected thigh the gluteofemoral crease on this side is much less distinctly marked than on the well buttock. In cases where the joint is the seat of an acute infection, following measles, scarlet fever, or the like, the same train of symptoms will be present, though the progress of the disease will be much more rapid, while combined with the local symptoms will be found those of general systemic infection, and under these circumstances disintegration of the joint may progress with remarkable activity.

In **syphilis** of the hip, on the contrary, the disease may have been present for months without the occurrence of pain sufficient to attract the parents' attention. It is only when a marked limp becomes notice-

able that medical advice is sought, and in some of these cases, when marked deformity is present and joint-spasm is very pronounced, manipulation seems to give rise to but trifling inconvenience, and the parents at times are loath to believe that serious trouble exists, because the child complains so very little.

In tuberculosis of the hip the pain at the outset is not apt to be marked; but, should an abscess form in the femur or the disease progress until the cartilage becomes involved, the pain becomes most exquisite, children often crying severely from the jar occasioned by a person walking on the floor, and so shaking the bed.

In some of these cases there is a distinct history of traumatism, and in others it seems impossible to find precisely when the disease began, many of the cases which come to the surgeon with the history that the first symptoms were noted by the parents a few days previous being evidently of very long standing, the inattention of the parents to the trifling limp which the child exhibits, and the fact that it did not at first complain of pain sufficiently to attract their attention, being responsible for this. Quite frequently these children complain of being stiff on rising in the morning, and exhibit a decided limp, but after having been at play for some hours they run in almost a natural manner, and little is thought of it. In some cases this limp gets better and may almost disappear for a number of weeks, occasionally a couple of months, then reappear in a still more aggravated form, to subside once more, and again reappear. It is unusual, however, for cases to pursue this course, and the majority grow

progressively worse, and do not, unless treated, exhibit these periods of freedom from symptoms.

The difficulty and obscurity that frequently beset the diagnosis between hip-joint disease and iliopsoas abscess are due to the fact that that term covers a group of affections. A syndrome has, in the writer's experience, invariably been associated with a tuberculous focus in the head of the bone that has opened into and infected the bursa lying beneath the iliopsoas muscle. This consists in the fact that the position assumed by the affected limb when the child is laid on its back is one of flexion combined with abduction and eversion. The patient besides invariably grasps the thigh firmly with the hand of the same side. Suppuration of the bursa beneath the iliopsoas is always present in this condition. Russell (*Intercolonial Med. Jour. of Austral.*, Oct., 1908).

Hysterical coxalgia must be borne in mind in the diagnosis. It is not always easy, even under anesthesia and the X-ray; the facility of movement of the supposedly inflamed joint is important. Perfectly healthy femurs have been disarticulated under misapprehension of a tuberculosis, especially after prolonged immobilization of the joint. The treatment is psychic. Broca (*Presse méd.*, Aug. 30, 1911).

The obturator nerve sends a little filament to the inner side of the knee-joint as well as to the hip-joint, and to this fact is due the characteristic pain in the knee which usually accompanies disease in the hip-joint, and which, in the great majority of cases, antedates the occurrence of pain in the joint itself. The obturator nerve often joins the long saphenous, which accounts for the fact that pain in the big toe is very frequently noted before pain in the knee, which, however, seems to have escaped the at-

tention of a good many writers on this subject. Quite frequently children will be brought for observation because they limp and because they have complained of pain in the big



Fibrous ankylosis of the left hip-joint following typhoid fever, relieved by *brisement forcé*.

toe, which the mother had supposed was due to some defect of the shoe or stocking or an ingrowing nail. Examination in these cases will frequently reveal the presence of hip-joint disease.

One of the first signs which are present in inflammation of any joint

is spasm of the muscles controlling the motions of that joint. In hip disease efforts have been made to draw inferences, on account of the preponderance of spasm in a particular group of muscles, as to the location of the disease in the joint, but so far without having put us in a position to diagnose with exactness the location of the focus of inflammation from the presence of spasm in certain groups of muscles. Not infrequently there may be noted, in addition to the spasm of the muscles immediately controlling the joint, spasm of the calf-muscles, although attention has very seldom been drawn to this fact. It often will be seen quite pronounced in the early stages of the disease, when deformity is very slight and limitation of movement in the hip-joint but slightly marked. It will usually be found in those cases where pain in the great toe has been noted instead of pain in the knee.

Hand in hand with muscular spasm comes atrophy of the muscles affected by the spasm, and this atrophy shows itself too promptly to be attributed wholly to disuse, and seems to be dependent on impaired nutrition. It is one of the earliest and most important signs in connection with joint spasm in the diagnosis of incipient and doubtful cases, being of vastly more importance than the occurrence of pain; but usually it is not present until the disease has been in existence for some time.

The position assumed by patients with disease in the hip-joint varies according to the progress which the disease has made. At the outset the almost invariable rule is that the patient bears the weight of the body upon the sound leg, the toes of the

affected side being turned slightly outward, the thigh being flexed, the leg everted and slightly abducted; the buttock on this side is decidedly flattened, and the gluteofemoral crease lower down and more or less obliterated. On account of the abduction of the leg it seems longer than its fellow, but if accurate measurements be taken, with the limbs in the same relative position to the median line, this will be found to be an apparent, and not an actual, lengthening. As the disease advances, this distortion becomes more and more marked, until the thigh may be flexed almost to the point of striking the chest, and the leg everted and abducted to the limit of possible motion. If the capsule has been greatly distended with fluid, it may spontaneously rupture, or some sudden movement may rupture it, and the leg may pass in a very short time from the position of extreme abduction and external rotation to one of adduction and internal rotation. Quite frequently this change accompanying the rupture of the capsule is followed by marked relief from the pain of which the patient had previously complained. This position of adduction was formerly spoken of as the "third stage" of hip-joint disease, that of marked flexion and eversion being called the "second stage," while the former position of slight flexion was denominated the "first stage" of the disease. And for purposes of explanation, it possibly may be well to retain these terms in some cases, though they do not represent invariably the different stages in the progress of the disease, as we sometimes find cases with marked adduction in the commencement of the disease, though in such

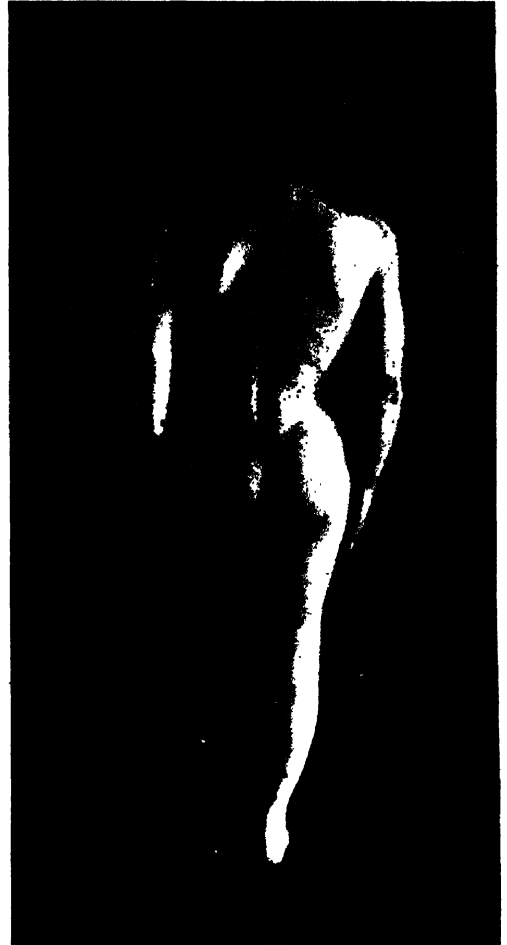
cases we usually find the leg is rotated outward instead of being rotated inward, as it is when the thigh passes from the position of extreme eversion and abduction to that of adduction.

Coincident with the change of position from abduction to adduction, there comes a change from apparent lengthening to apparent shortening of the limb. If the disease has been in existence some time, there may be actual diminution in the length of the leg from absorption of bone, as well as the apparent shortening due to the adducted position in which the limb is held.

In over 500 cases of coxalgia the writer has observed 10 in which a brief subacute arthritis healed without impairment of movement, but a pre-existing deformity of the bone persisted unmodified. The children had coxa vara or hypertrophy, atrophy or deformity of the head of the femur, but there was no destruction of bone tissue at any point. The type does not correspond to any of the known forms of hip-joint disease, and it has generally been mistakenly diagnosed as a tuberculous coxitis. The children begin to be occasionally a little lame and complain of pain in the knee, the movements of the joint are limited, and there is some muscular atrophy in the region. After a certain period the pain subsides, with or without extension in the interim, and the children walk normally or with a slight limp. Calvé (*Revue de chir.*, July, 1910).

DIAGNOSIS.—The diagnosis in hip-joint disease should only be difficult in the early stages. If a child is brought complaining of a limp, an obscure pain in the toe, calf, or knee, do not be satisfied with finding something in the toe, calf, or knee which may account for its limp and pain,

because it may possibly have disease of the hip in addition to its other ailments; but strip it, and watch its position with great care, allowing it sufficient time to become composed and assume its natural attitude, as quite frequently, under the influence



Appearance at the outset. (Sayre.)

of excitement, slight disturbances of function may easily be masked. After noting any of the abnormalities of attitude which have been just described, place the child upon its back upon a hard surface,—a table covered with a shawl, for instance. It is important that the surface be not so thickly covered as to leave a yielding

surface for the back to rest upon, as slight alterations in the position of the pelvis may then pass unobserved. With the normal child lying on its back, with its pelvis in such a position that a line drawn from the center of the sternum over the umbilicus through the symphysis pubis is at right angles to a line joining the two

leg gently to the table, and if there is involvement of the hip the psoas and iliacus or rectus femoris muscles will be sufficiently contracted to tilt the pelvis before the leg comes into contact with the table, and a slight arching of the lumbar spine will result. This tilting of the pelvis does not necessarily mean the presence of



Right hip-joint disease showing position in which leg must be placed to make back lie flat on table.

anterosuperior spines of the ilia, the entire back should rest upon the table while the lower extremities are in a straight line with the trunk, and also rest upon the table. If there is any arching of the lumbar spine, raise both legs until the entire spine rests upon the table, and then lower the side which you believe to be the sound one until the back of the leg rests upon the table. If the joint of that side be unaffected, there will be no change in the position of the trunk and pelvis, and the spine will remain in contact with the table. Now lower the other

hip-joint disease. It means a contraction of the iliopsoas muscle, which may be caused by inflammation of the spine, by appendicitis, or by salpingitis; but the previous history of the last two affections would exclude them from consideration, while careful examination of the spine should clear up the diagnosis between disease of the hip and disease of the spine, though in some cases both exist simultaneously, and the mistake of recognizing only one is sometimes made even by men of experience.

Both legs, lying flat upon the table,

should then be moved to and fro, to ascertain, if possible, the presence or absence of muscular spasm.

It is frequently advised that an anesthetic be administered, in order that the condition of a diseased joint may be thoroughly investigated. As far as diagnosis is concerned, this is absolutely unnecessary. The administration of the anesthetic, by the removal of the sensitiveness from the joint, removes the necessity which

nosis, is, first, to thoroughly gain control of the patient, and cause it to allow complete muscular relaxation, as a child will, in many instances, voluntarily stiffen its muscles when first examined, and thus mask the presence of a slight involuntary spasm. The joints should then be moved through all normal ranges of motion, beginning with the sound side, and slight involuntary twitches taken into account. It is usually



Right hip-joint disease, showing tilting of pelvis.

nature feels for establishing the involuntary muscular protection which she gives all inflamed joints, and thus removes from the surgeon a most valuable means of diagnosis. If the rigidity of the joint is due to adhesions, and so persists after the anesthetic has been administered, the case has been of such long standing that there should be no difficulty in reaching a diagnosis even by an inexperienced observer.

The mode in which to determine muscular spasm in the early stages of the disease, at which time it is most important to arrive at a correct diag-

quite unnecessary to manipulate the joint so violently as to cause pain, in order to arrive at a correct diagnosis, and, in the majority of cases, pain will not be elicited unless very extensive movements are made, and unless the limitation of motion which nature puts to the joint is violently overcome. Pressure over the hip-joint proper may at times give rise to pain; it very frequently does, but in many cases pain cannot be so elicited.

The length of the two lower extremities should now be noted, the distance from the anterior spine of the ilium to the internal malleolus

being taken as the most reliable measure; and in this connection care must be exercised that both extremities occupy the same relative position to the trunk at the time the measures are taken or they will be of no value, flexion and adduction causing much apparent shortening, while abduction causes apparent lengthening.

The relation of the trochanters to Nélaton's line should be noted, by passing a string from the antero-superior spine of the ilium to the tuberosity of the ischium. Normally this line should just touch the upper border of the great trochanter. If the latter lies above it, the cause may be fracture of the neck of the femur, congenital dislocation of the hip on the dorsum of the ilium, bending of the neck of the femur, absorption of the head or neck of the femur, or absorption of the upper part of the rim of the acetabulum, allowing the femur to glide upward. Which cause is present in each case must be determined by the surgeon.

Atrophy of the muscles occurs early in joint disease, and the circumference of each thigh should be noted, both at the upper portion and also at a point lower down,—say, 4 inches above the knee,—care being taken to measure the thighs at corresponding points, or the results will be useless.

In noting muscular spasm care must be had not to mistake the flaccidity of a paralyzed muscle for the normal state, and suppose the healthy side to be the seat of muscular spasm by contrast. The fact that the more relaxed thigh was the smaller ought to clear up any possibility of error, and it would seem that it hardly required mention save for the fact that such mistakes have occurred.

The temperature and pulse should also be noted, any elevation of the former above normal being taken, in a doubtful case of every incipient disease, as conclusive proof that disease is present, especially if there is present in addition an accelerated pulse.

The amount of elevation of temperature is a fair index of the violence of the inflammatory process.

Disease in the sacroiliac joint should be differentiated from hip-joint disease primarily by the position which the patient assumes while standing, the body being sharply bent through the lumbar spine, away from the diseased side, in order to free the articulation from pressure. This position, which is typical of disease in the sacroiliac or sacrolumbar joint, is not easy to describe, but, once seen, cannot be mistaken for anything else. Pressure of the two ilia toward each other gives rise to pain by compression of the diseased joint. Pain, in like manner, would be produced if pressure were made with the hands on the great trochanters, which might lead to doubt as to whether the disease were in the sacroiliac or the hip-joint; but if the disease were in the hip-joint and the pain were caused by pressure with the hands on both trochanters, pain would not be caused by pressing the ilia together with the hands behind the hip-joint, and the diagnosis would be cleared up in this manner. Direct pressure over the sacroiliac joint also gives rise to pain, and rotation of the hip fails to produce muscular spasm.

Congenital dislocation of the hip may be mistaken for hip-joint disease, but the history is different: there is no history of traumatism, and there is usually no history of pain. The dis-



Comparison between tuberculous and healthy hip-joints, showing absorption of the head and neck of the femur, rarefaction of the head, and absorption of the acetabulum. Normal side shows epiphyseal cartilage below the head of the femur and cartilage in the acetabulum, where innominate bone has not yet ossified. Bandages and adhesive plasters show on thigh of diseased side. (Sayre.)

turbance of gait has been noticed from the first efforts at walking, which generally have been made long after the time at which children ordinarily commence to walk, and there is usually marked prominence of the buttock on the side of the dislocation, and while the child is recumbent the head of the bone can be caused to glide upon the dorsum of the ilium, while the great trochanter is felt to approach and recede from the crest of the ilium. The only point in common with hip-joint disease is the limp, which, however, is different in its characteristics from the limp of hip disease, and the fact that the great trochanter is above Nélaton's line. In hip disease the trochanter would only be above Nélaton's line in an advanced case, whose history would be absolutely different from that of congenital dislocation of the hip.

Confusion may arise at times in regard to **fractures of the neck of the femur** in small children where there is a history of traumatism, pain, and limping, but the diagnosis can usually be made by the fact that the disability and the pain immediately followed the traumatism, and the great trochanter was immediately found to be above Nélaton's line; the only confusion possible being in cases which do not come under observation for months after the occurrence of the symptoms and where no history can be obtained. Such cases often present a picture of flexion and adduction which greatly resembles that of old hip-joint disease with absorption of the head of the femur.

In **coxa vara**, caused by the bending of the neck of the femur, the diagnosis is more obscure. In these cases, also, the great trochanter may be

above Nélaton's line. The motion of the joint may be limited, but careful investigation of the relation existing between the trochanter and the head of the femur, in combination with the direction of the neck of the femur to the shaft, and differentiation between the limitation of motion produced by spasm of the muscles and that caused by abnormal relations of the neck of the femur, which cause the latter to strike the ilium, will clear up the diagnosis.

Cysts of the femoral neck may occur, which so weaken the bone as to give rise to coxa vara. Their progress should be carefully watched by means of the X-ray and if improvement does not take place the trochanter major should be tunneled, the cyst cleansed out, and the wound packed. In cases of osteofibrosis of the femoral neck supports should be given, as in cases of tuberculosis, lest coxa vara result. These cases seem to be the result of perverted metabolism, perhaps caused by failure of some of the ductless glands to do their work, and artificial feeding with these glands is being used more or less empirically. Such children are usually remarkably fat and have undeveloped genitalia.

At times periostitis of the great trochanter may simulate quite closely hip disease, pressure over the trochanter giving rise to acute pain. If the head of the femur, however, be pressed into the acetabulum by one hand on the middle of the thigh while the knee is abducted with the other, no pain is produced and the sensitive spot is thus located in the trochanter and not in the head of the femur.

The occurrence of tumors of the femur and ilium should not be over-

looked. These are almost always sarcomata, and can usually be differentiated from tuberculosis or syphilis by the rapid enlargement of bone usually following quite soon after a traumatism associated with pain, which is usually caused by pressure on nerve trunks and does not resemble in its characteristics the night cries of ordinary hip-joint disease. Muscular spasm is also usually wanting. The importance of a correct diagnosis being reached very early in such cases cannot be overestimated, as it is only by prompt amputation that life can be saved.

A point to be borne in mind in making a diagnosis of abscess in connection with a fluctuating swelling on the buttock is the possibility of confounding one with an aneurism, as there is on record a case of gluteal aneurism that was opened with fatal result under the impression that it was an abscess. It is always best to confirm the diagnosis by aspiration.

ETIOLOGY.—The ordinary accepted type of "hip disease" or "*morb. coxarius*" is a tuberculosis, which in the vast majority of instances begins in the bone, though it may, in exceptional instances, commence in the synovial membrane.

How the tubercle bacilli gain access to the bone is a matter which is still under discussion. It is probable that the bacilli are present in the circulation, and that under the influence of a traumatism, not necessarily severe, a lowering of the resistance is produced in the neighborhood of the joint sufficient to favor the local development of bacilli which have been present in the general system for a long time, but which had not increased on account of lack of suitable conditions.

Tuberculous material was injected by Müller into the femoral artery of animals with negative results. When injected into the crural artery from which the nutrient artery of the femur arises or into the nutrient artery itself, typical bone tuberculosis was set up.

Tuberculous matter from phthisical lungs injected into animals' joints sets up tuberculous joint disease, while injection of inorganic matter not containing tuberculous matter either into the joints or general condition does not cause tuberculosis.

Schüller rendered guinea-pigs and dogs tuberculous by inhaling solutions of tuberculous material from diseased lungs and injected the same into the animals' lungs. The joints of these animals were then wrenched or bruised, which produced a typical chronic tuberculous synovitis in a great proportion of the cases, while healthy animals whose joints were similarly treated suffered from only a temporary sprain. Fraser found that injection of bacilli into the femoral artery did not set up tuberculosis of the knee unless the femoral vein was occluded, but when this was done tuberculosis of the bone invariably occurred.

The exanthemata are frequently followed by joint-tuberculosis—apparently on account of the lowering of the general vitality below the point where the tissues are capable of resisting the growth of the tubercle bacilli.

PATHOLOGY.—In the early stages of hip-joint disease there is a hyperemia in the cancellous tissue about the epiphysis where the disease usually begins, in the center of which a small, gray tubercle appears.

The capillaries in the Haversian canals become blocked up with bacilli. A hyperemia is kept up, the trabeculae in the hyperemic area are absorbed, enlarged bone-spaces are formed, and fatty degeneration of the bone-cells occurs.

The gray spot in the center of the hyperemic area increases in size; its center begins to grow yellow; other similar spots occur and merge into each other; the center breaks down and becomes a semisolid, cheesy mass and may turn into pus.

The blood-vessels in the periphery of the inflamed area often become so blocked that the blood-supply is cut off, and necrosis of a larger or smaller part of the apophysis of the femur results. If all conditions are favorable, the focus may become absorbed or may become calcified, or else as the focus of disease increases in size it may grow toward the surface of the femur, open outside the joint-cavity, and the case may run a comparatively short course with little or no destruction of the joint, or, as is more usual, it may break into the joint itself, setting up a purulent synovitis.

The synovial membrane becomes inflamed and thickened, the blood-vessels are engorged, an increased serous or seropurulent effusion takes place, and the joint becomes filled with a gelatinous mass; the cartilage becomes eroded, and the bare ends of the bone come into contact.

If the process becomes less violent, on the contrary, the granulations become firmer and not so pale and gradually give place to fibrous tissue, adhesions forming between the joint-surfaces, scar-tissue taking the place of the granulations, and contraction of the capsule limiting joint motion.

When the focus of disease is in the ilium, the area of inflammation may advance toward the pelvis as well as toward the acetabulum, and in these cases the periosteum lining of the ilium on its inner side becomes much thickened. At times the entire bottom of the acetabulum may be absorbed and the head of the femur pass into the pelvis; at other times there is only a small hole through which pus passes to form an abscess which may burst into the bladder or rectum or burrow under the adductor tendons or out on the buttock. Even in this condition recovery is not impossible.

The size of the acetabulum is often increased by the progress of erosion and also by the action of reflex muscular spasm in crowding the head of the femur against the upper rim of the acetabulum, cases having been reported in which the head of the bone lay inside the pelvis in spite of the limbs' having been kept parallel by plaster of Paris, which had prevented the occurrence of deformity.

The importance of this fact as bearing on the necessity of traction as well as fixation in the treatment of the disease should not be overlooked.

The erosion of the upper part of the acetabulum accounts for part of the shortening in some cases of hip disease. Retardation of growth may give actual shortening of the femur, and it is not unusual to find that the leg and foot of the affected side are also smaller than their fellows.

If the disease progresses, sinuses may burrow from the joint in all directions both inside and outside the pelvis, and later on amyloid changes in the liver and kidneys will be set up, or a tuberculous meningitis or a general tuberculosis may set in.

PROGNOSIS.—Prognosis in disease of the hip-joint varies very much, being largely determined by the amount of destruction which has taken place before the case comes under observation, the amount of recuperative force possessed by the patient, and the intelligence of home co-operation—the last, perhaps, being the most essential element.

Cases of syphilitic disease ought to give excellent results, if to local protection of the joint be added thorough, persistent antisymphilitic treatment.

Cases of acute traumatic synovitis, if seen at once, and given absolute and complete rest, almost always recover perfectly.

Cases of acute infectious osteomyelitis demand prompt operation and removal of diseased foci. If this can be done before too much general systemic infection has taken place, prompt recovery usually follows.

In tuberculous cases, seen early, recovery, as a general thing, takes place. The time which a patient will have to wear a splint is very seldom under two years. If the patient is able to dispense with it inside of this time, it is remarkably fortunate, and the parent should not be led to anticipate such a result. The amount of shortening which may take place, and the amount of impairment of motion, cannot always be accurately determined beforehand, and it is very unsafe to make a definite prognosis. Cases may be seen at apparently the same time after the onset of the first symptoms, with apparently the same amount of disease, be treated in precisely similar manner, and while one recovers with an absolutely perfect joint at the end of two years, the

other may drag on a tedious course of four, five, or six years, and at the end of that time recover with decided shortening and marked diminution of motion. The only difference in the two cases apparently having been the personal equation of power to resist disease. What can be promised is that, if the patient's recuperative force is sufficient to allow it to recover at all, it can recover with a leg parallel with its fellow, and not flexed upon the trunk, and the parents may be told that the length of time during which a splint will probably have to be employed will not be less than two years.

Case of hip-joint disease occurring at the age of 3 years in which the patient recovered so completely after wearing a long hip splint that at 14 years he ran 5 miles in thirty-two and one-half minutes. Wyeth (Med. Rec., Apr. 23, 1910).

The question of abscess also comes into the prognosis, and parents are frequently anxious to know whether or not a child will have an abscess. In many cases there is felt at the time of first examination a brawny, porky induration around the hip-joint, which is the forerunner of an abscess, or the child may be found with an inflamed, sensitive joint which absolutely precludes any possibility of motion; in such cases it is quite probable that an abscess will develop more or less speedily. In other cases, where the patient is seen early, and the brawny induration is as yet not present, no definite prognosis can be given, though the percentage of cases that develop abscesses when thorough treatment is carried out from an early stage of disease is decidedly small.

TREATMENT.—The indications for treatment in disease of the hip-joint are, primarily, to give the joint physiological rest, and, secondarily, if the general condition of the patient demands special treatment to counteract syphilis, rheumatism, etc., to carry out the measures indicated.

Report of 900 cases of tuberculous hip-joint treated at the Alexandra Hospital without operation (other than the opening of abscess) by **rest** and **extension**, good nursing and food, with a mortality of less than 4 per cent. In about 40 cases both hips were affected. There is absolute rest in the recumbent posture. The joints involved are kept absolutely quiet, and, if necessary, splints are used to insure this at first. Extension is applied in the long axis of the limb in the easiest position. Bowlby (Brit. Med. Jour., June 20, 1908).

At the Mayo clinic, the acute stage in children is treated by the **Jones abduction frame**, whereas in adults this stage may be treated by **Buck's extension** in bed, with a sandbag support for the leg. In the subacute stage, in cases without drainage, a **cast** of the Lorenz type may be applied with the use of crutches and the elevation of the sound limb by means of a patten. Finally a **Thomas splint** is used for 3 or 4 months, at the end of which period, when weight carrying is permitted and causes no pain, crutches are allowed. Of his cases 90 per cent. showed deformity, the flexion abduction type being practically always present; 19 per cent. had ankylosis, and the average shortening was $2\frac{1}{4}$ inches. In 60 per cent. the right hip was the seat of deformity, 10 per cent. required **aspiration**, and 14 per cent. required **curettage** or **sequestrectomy**. Patients with deformity and those in the subacute stages were treated by brisement forcé, plaster of Paris, and crutches. **Osteotomy** of the Grant type was done in the cases with ankylosed deformity. H. W. Meyerding (Minn. Med., Aug., 1918).

To obtain rest of a joint like the hip is not easy. The **Thomas hip-splint** endeavors to secure it by fixing the trunk and lower extremity by means of an iron bar $\frac{3}{4}$ inch by $\frac{3}{16}$ inch and long enough to extend from the scapula to the lower third of the calf and fitted with cross-bars long enough to embrace three-fourths of the circumference of that part of the body where they are placed, namely: at the thorax, calf, and upper third of the thigh. The splint is padded with felt, covered with leather and bent to fit the contour of the body in its deformed position, and then bandaged firmly to it. In acute synovitis of the hip it is an excellent means of treatment, and in cases where no other form of treatment is practicable is capable of doing much good. The fixation which it gives the hip, however, does not counteract the reflex muscular spasm which in chronic joint disease creates so much of the destruction which is seen in cases left to nature, and which is capable of causing perforation of the acetabulum in cases which have been simply prevented from having flexion, but not treated with traction.

Fixation can also be given tolerably well by a **plaster-of-Paris spica** to the thorax, but the prevalent custom of permitting children with inflamed hips to walk on such limbs in plaster spicas is unwise and more apt to result in ankylosis than when the traction splint is employed.

Lorenz employs a **short plaster-of-Paris spica encasing thigh and pelvis only**. This gives absolute immobilization of the hip-joint, and the position of natural rest and protection, abduction and extension, can be produced while it is being applied and maintained naturally by it after it

has hardened. The result of treating hip-joint disease by this means is satisfactory enough to make its employment very general. Keppler (*Amer. Jour. of Obstet.*, Nov., 1912).

Traction in the proper line and of sufficient amount to relieve involuntary muscular spasm and so lessen intra-articular pressure is the best agent we possess for relieving pain in chronic joint disease and should always be added to any apparatus that is employed for securing fixation, as the latter, unless thus supplemented, but partially fulfills its mission.

Pathologically considered, it would seem that the weight of the body should never be considered as safe until one is assured that all active disease, all exacerbations, have passed. The writer's clinical experience has led him to believe that the danger is not real. If the motion of the affected joint is put out of action, the weight of the body in walking may be useful rather than harmful. In a case of hip disease of rather acute invasion, for example, there were rather extensive changes in the head and neck, as shown by the X-rays, and deformity. **Traction** was employed at first, but fixation by a **short plaster-of-Paris spica bandage**, with use of the limb, was employed during the greater period of treatment. After about four and one-half years of this treatment the result was almost perfect. Seven other cases were treated in a similar manner, with excellent results. Gibney (*Amer. Jour. Orthop. Surg.*, vi, p. 21, 1908).

Another objection to the Thomas splint is the method by which it straightens the deformity, which is effected by bending the splint backward by wrenches from time to time. If there is contraction of the flexor muscles, this proceeding must result in crowding the head of the bone vio-

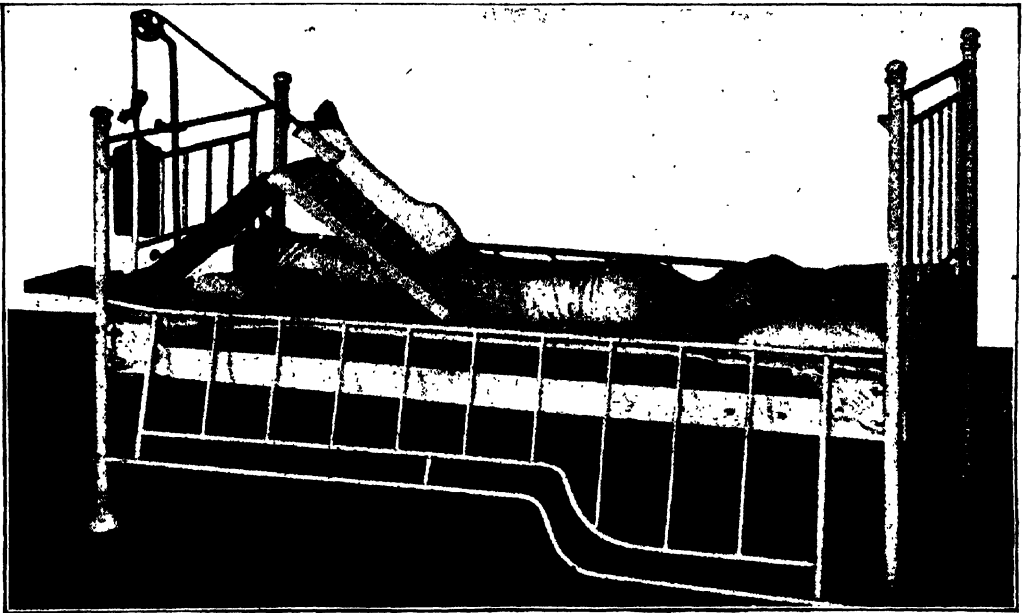
lently against the acetabulum, thus running the risk of re-exciting inflammation.

In the majority of cases there is too much deformity when they first come under observation to permit the application of a splint. Such patients should be put to **bed, a long padded side-splint, with a cross-bar at the bottom**, should be firmly bandaged against the sound leg and the trunk as far as the axilla, and the **body and leg** thus secured may, if necessary, be **fastened to the sides of the bed** for the purpose of retaining them in position.

It is sometimes found better to bandage the patient with **Bradford's frame**, a rectangle of iron gas-pipe somewhat longer and broader than the child, which has canvas stretched tightly across it except at the part where the hips lie, which is left open for a bed-pan. A long board should be placed under the mattress, as the ordinary spring-mattress is too yielding to allow proper control of an inflamed joint. **Adhesive-plaster straps**, furnished with buckles at one end, are next applied to the diseased limb, the buckles being just above the malleoli, and the plaster extending as high on the thigh as possible. Heavy extension **diachylon plaster**, spread on mole-skin, is best for this purpose, as the ordinary rubber plaster is irritating to many skins when worn for a long time, and is spread upon such thin cloth as to be incapable of enduring the strain necessary in many cases to afford relief. In applying the plaster it should be warmed but very little, and in many cases need not be warmed at all, but should be snugly bandaged to the skin, and well rubbed with the hand to secure coaptation of

the plaster. This tight bandage may then be removed and replaced by one not so closely bound. Some prefer, in addition to the two side straps of plaster, a spiral of plaster passing around the leg in both directions, which serves to hold the plaster more snugly in position. Properly applied extension plasters should remain for several months without the necessity of change. To the buckles are now

When the body and sound leg are firmly bandaged to the side-splint and the back is flat upon the bed, the diseased limb will assume a position either of abduction or adduction, combined with flexion, and in this position, whatever it may be, the line of **traction** must be made. The amount of traction must be made sufficiently great to give the patient freedom from pain. If traction, so applied,



Extension apparatus.

attached small leather straps, which are fastened to a cross-bar below the sole of the foot, from which cross-bar a stout cord extends over a pulley-wheel at the foot of the bed and supports a **weight**. The amount of weight will vary in different cases, and should be that which experience shows gives the greatest amount of relief in the particular case, and may vary from 2 to 15 pounds. The direction in which the traction is made should be determined by the deformity which is present in each particular case.

fails to relieve pain, and the position is that of adduction, a **second line of traction** may be made by passing a well-padded band around the thigh, close to the groin, and making traction **outward** at right angles to the long axis of the femur, over a pulley fastened to the side of the bed. The **leg** must be **supported** in its elevated position by pillows or by two boards hinged at one end and supplied with a prop, so as to make an **inclined plane** which can be raised or depressed according to the needs of the patient. If there is great tenderness behind

the trochanter, a **blister** may be applied with great benefit.

In cases of osteitis of the trochanter with marked tenderness, relief can frequently be obtained by plunging the sharp point of **Paquelin's cautery** deep



Long traction hip-splint with thorax belt. (Sayre.)

into the bone, the skin over the trochanter having been anesthetized by a few drops of a 1 per cent. solution of cocaine. In exceptional cases there may be an effusion in the joint of so great extent as to make **aspiration** advisable, but this is unusual. If the synovitis becomes purulent the **joint** must be **incised** and washed out with **Thiersch** or **Labarraque** solution.

The **line of traction** is to be **changed** little by little **every few days**, as the spasm of the muscles subsides, until the leg is gradually brought parallel to its fellow and flat in bed, without disturbing the position of the trunk and the sound leg. When the legs can be made parallel and rest on the bed without tilting the pelvis, a **splint** may be applied. In some cases the disease will have advanced so far at the time of first observation that adhesions will have formed around the joint too strong to permit reduction of the deformity in this manner. And in such cases, where faithful trial of this method of reducing the deformity fails to give results, the patient should be anesthetized and the **joint forcibly straightened**. If at this time it is found that there is so much contraction of the rectus muscle or the adductors as to prevent reduction of the deformity, except at the expense of violently crowding the head of the femur into the acetabulum, **free section of the contracted tissues** should be made before reduction is attempted. The **joint** should then be **immobilized** either with a splint or with a plaster-of-Paris dressing extending from the ankle to the thorax, while **weight-and-pulley traction** is again resumed. If plaster of Paris is employed, it should be reinforced at the groin by a strip of iron or bass-wood to prevent cracking. When the deformity has been overcome and the joint is free from active inflammation, the patient may be allowed to rise when supplied with a suitable apparatus.

The object of the **hip-splints** now in use is twofold: First, to enable the patient to walk about easily without bearing weight upon the diseased

joint, and, second, to prevent the joint from receiving the traumatism consequent upon ordinary motion. If the patient is very large and fat or the joint extremely sensitive, it will be found wise to use a pair of **crutches** in addition to the hip-splint, as the joint in this manner will be better protected and the patient freed from the galling sometimes occasioned by the pressure of the perineal straps in very heavy and fat patients. In the great majority of cases the apparatus most suitable for protecting the joint consists of a **thorax belt and a pelvis belt with a bar running down the outer side of the leg** to a point a couple of inches below the sole of the foot, where it joins a cross-bar, to which are attached two straps, which serve to fasten the instrument to the buckles on the adhesive plaster. By means of a ratchet and key on the footpiece which is attached to a notched bar sliding inside of the main bar, which is hollow, the splint may be made longer or shorter. Just above the knee a metal horseshoe-shaped collar holds the thigh in position. Two straps pass from the front of the pelvis belt to the rear, between the legs, and serve to hold the pelvis belt in position. The buckles to which these straps are attached should be near together in the front, to avoid pressure on the femoral vessels, and widely separated at the back in order that the pressure may come under the tuberosity of each ischium.

An elastic strap runs from the middle of the back bar of the pelvis belt to the side rod to prevent the pelvis belt from tipping up too far in the back. When applied the pelvis belt is to be fastened sufficiently firm by the perineal straps to prevent it

from rising higher than the antero-superior spines of the ilia, while the footpiece is buckled to the extension straps, leaving $2\frac{1}{2}$ to 3 inches between the sole of the foot and the top of the footpiece. By means of the ratchet and key extension is then made until the patient is comfortable. As the splint projects below the level of the foot, an extra sole and heel must be added to the shoe of the opposite side, which should usually be about 4 inches high, and the splint should be so regulated that, when the proper amount of traction is made, the patient being upright, the length of the splint and the length of the sound leg with the high shoe will be the same. The splint should be sufficiently long to prevent the patient from touching the foot to the floor, and, if the elevation on the opposite shoe is not high enough to compensate for this elongation, walking will be very uncomfortable. In the majority of cases a splint of this kind gives adequate protection and results in excellent cures. But if it is found that the parents do not fully understand the home management of the apparatus, or if the patient lives at a distance, so that it is seen at infrequent intervals, it may be wise to **add to the splint a thorax belt**, which is joined to the pelvis belt by means of a rod continuous with that passing down the side of the leg. This form of splint prevents the occurrence of flexion after the patient is allowed to walk, which sometimes takes place if there is no thorax belt on the splint, but it has the disadvantage of limiting the motions of the patient very materially, and being much more cumbersome. With the patients, however, who live at a distance, and where home co-operation

is not intelligent, it is wise to employ it. The mistake must not be made of placing a joint in the bar that runs from the foot to the thorax belt, as this will render the apparatus worthless. In some cases, also, instead of the perineal bands, it may be better to use a ring, as suggested by Dr. A. M. Phelps, for the latter cannot be tampered with by careless attendants, and, if it is fitted to the limb with proper care and sufficiently well padded, can be used with a fair degree of comfort. In adult cases where dependence can be placed upon intelligent co-operation of the patient, the use of the **short traction splint and crutches** may be advisable. In this form of splint the side rod terminates at the knee-joint and is joined to a pair of hoop-shaped metal bars, which pass across the front of the femur and are supplied with two jaws on each side of the knee just above the condyles. Adhesive plasters are fastened to the thigh, terminating in broad, webbing bands, which are reversed over the jaws of the splint and fastened to buckles. By means of a ratchet and key traction on the joint is made in the same manner as in the case of the long splint.

The treatment of abscesses occurring in tuberculous joints is one which has been very widely discussed, and in regard to which there have been many different opinions. The prevailing trouble with many surgeons is that they fail to regard the abscess as an incident in the career of a tuberculous joint, and treat it as a thing by itself, neglecting the bone inflammation which was the original starting point of the abscess. If it were possible to locate the focus or foci of disease and to remove all foci

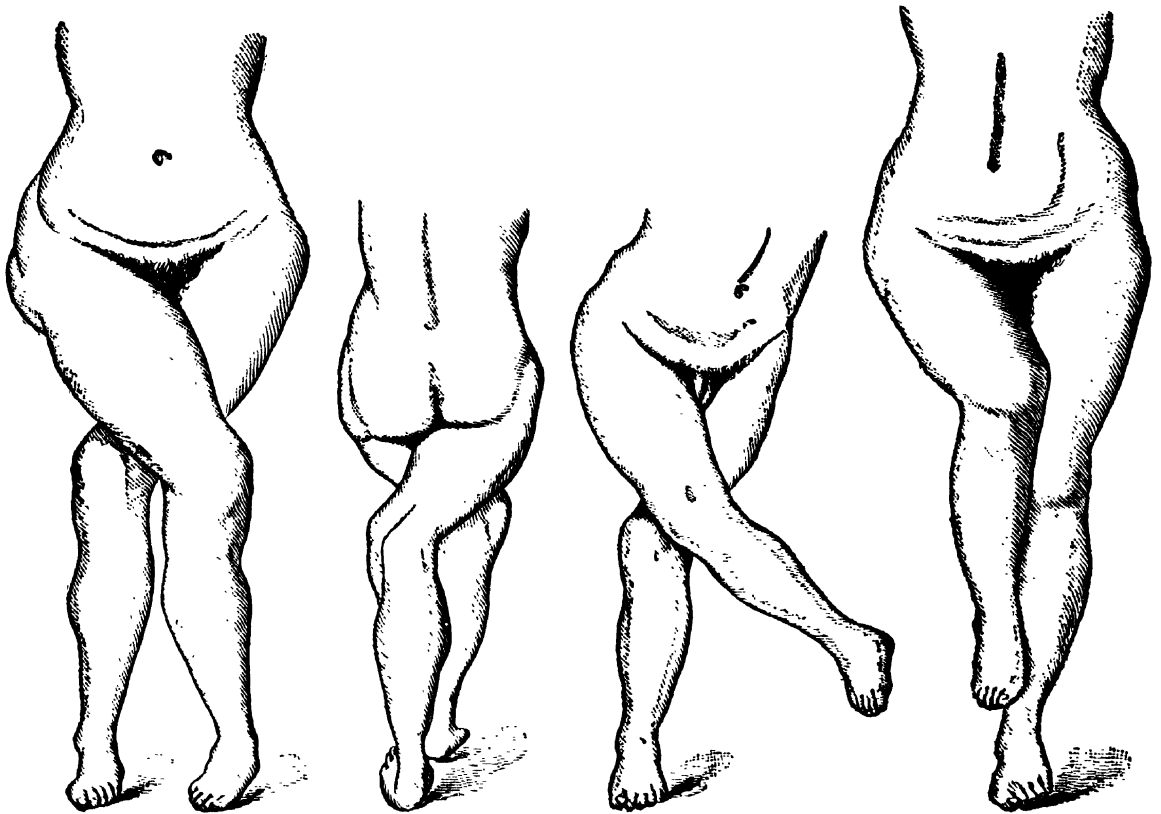
without doing great damage to surrounding healthy parts, the logical treatment of all tuberculous inflammation would be the radical **excision of all tuberculous foci** as soon as detected. This proceeding, indeed, became quite fashionable some years ago abroad, but experience has shown that better results are obtained by older and more conservative methods. If we cannot absolutely eradicate all tuberculous foci, the chances of securing a good result are better by leaving them alone, provided they remain encapsulated and are not subjecting the patient to general systemic infection. Under **rest and compression**, good **hygienic surroundings**, and **forced feeding** many collections of tuberculous matter disappear. If they come to the surface it is the best plan in many cases to **disinfect the skin** with great thoroughness, apply a **sterilized dressing**, and **allow them to open spontaneously**; wash the cavity thoroughly with **hydrogen dioxide** or **chlorinated soda (Labarraque's solution)**. Abscesses treated in this way rarely give rise to any disturbance and usually close in a few months.

Report of 102 cases of tuberculous hip-joint disease and its treatment with **bismuth paste**. (See BISMUTH, Vol. II, p. 474.) The prevention of bismuth poisoning consists in not allowing large quantities of the paste to remain in the body for absorption. Should the symptoms appear, the paste must be removed by washing out the cavity with warm olive oil. The sterile oil was injected and retained for from twelve to twenty-four hours, in order to produce an emulsion, which should be withdrawn by means of suction. After its removal all symptoms promptly disappear. Scraping out the paste with a scoop is a dangerous pro-

cedure because it opens fresh channels for absorption. E. G. Beck (New York Med. Jour., Jan. 24, 1914).

If there has been a mixed infection grafted on top of the original tuberculous focus, immediate operation with **free incision of the abscess**, complete

Many cases pass on to abscess quite promptly, and, indeed, it sometimes seems as if those cases which suppurated early and ran an acute course got well in shorter time than those which were accompanied with less pain and less suppuration. The occurrence of abscess does not neces-



Deformities following hip-joint diseases due to insufficient care during treatment. (Petit.)

removal of all *débris*, and thorough drainage should be employed. As a usual thing, the abscess has originated in the bone, and in the cavity will be found very frequently some crumbs of dead bone, although occasionally they are not present, while not infrequently, in cases opened at an advanced stage, the abscess seems to have been shut off from the original bone focus, which has healed up after extruding its carious bone.

sarily mean a less favorable result, and it is not unusual to see cases of double hip disease, one side having been the seat of an abscess and the other having been free from suppuration, in which the motion is better on the side where suppuration took place.

If great destruction of the head of the femur or the acetabulum are present when the case first comes under observation, or if, in spite of protection and good hygienic sur-

roundings, the case does not do well and disintegration of the joint is progressing, the question of **excision** presents itself. And here again the difficult problem is when to operate and when not. The great majority of cases seen in the early stages and properly treated never reach the point of operation, except in the class of acute infectious osteomyelitis. And, again, there are other patients who come to the surgeon, with grave hectic symptoms, a hip full of burrowing sinuses, and a mass of dead bone inclosed in a thick involucrum, who have no chance for life except by the prompt removal of all diseased tissue and proper drainage.

[Number of cases of resections of the hip recovered with very good motion. One has almost perfect motion; can run, dance, skate, and walk many miles without the slightest fatigue, although more than 3 inches of his femur and much of his acetabulum were removed; yet he has only $\frac{3}{4}$ inch shortening of the limb. LEWIS A. SAYRE, Assoc. Ed., Annual, 1890.]

Between these two extremes we find a third class, in which the surgeon at times is in doubt whether the continued use of a splint for a longer period of years is better, or whether a free removal of the head of the bone, scraping of the acetabulum, and removal of all tubercular tissue may not, in the end, give a better result. Such cases must be decided by each man on his own experience.

Study of 568 cases of **resection** of tuberculous hip-joint disease; 294 received conservative treatment; in 274 the joint was resected. Of the 294 patients treated conservatively information as to the final result was wanting in 92. Fifty-five patients died while under observation; 114 recovered so as to be able to go about without assistance; in 33 of

these the mobility and use of the joint became normal or nearly so; 90 had more or less movable joints. Aside from the 114 good recoveries 35 patients became able to go about with a cane or crutches, 3 of those with great difficulty. Fistulae persisted in 13 patients. Of the 274 patients upon whom resection was performed information as to the final result was wanting in 60. One hundred and nine patients died while under observation; 16 recovered and were able to go about without assistance and had no fistulae; in 16 the result was excellent, the patients were able to take long walks, do hard work, and could dance. Forty-three were able to go about with a cane, the remainder with crutches, but the condition of 5 of these was pitiable. Fistulae persisted after the operation in 35. It is not surprising that the final results in the cases not operated on were better than those where the operation was performed. One reason is that in the cases operated on the disease was more severe, for the writer usually operated only patients in whom the severity was such that there was little hope for recovery without intervention. Another reason is the danger of the operation. Double the number of patients died under observation that were operated upon. Nine of these died from collapse, 2 from hemorrhage, 7 from sepsis, and 2 from embolism. General acute tuberculosis carried off 14 of those conservatively treated, 24 of those operated upon. But it is noteworthy that of the bad cases operated on so large a number made good recoveries. König (N. Y. Med. Jour., from Berl. klin. Woch., Mar. 8, 1909).

Resection for tuberculous coxitis is unjustifiable in children under 15 years unless in the presence of infection or fistula. With this exception a **fixed dressing** renewed every month is the best procedure. In non-suppurative cases of knee-joint tuberculosis in children conservative treatment is indicated under all cir-

cumstances, but if suppuration occurs and fails to subside promptly under conservative methods, then **resection** is permissible in patients approaching the fifteenth year. Alop (Zeitsch. f. Orthop. Chir., Bd. 27, 1911).

The writer succeeded in reconstructing a tuberculous hip-joint so as to eliminate the disease and furnish a new and apparently serviceable head on the femur, by using an astragalus removed from the patient's own foot. This operation of **transplantation** was suggested by an astragalus which had been removed from a paralytic foot, and which showed striking similarity of contour, when held in certain positions, to the head and neck of the femur, and presented so large an articulating surface that it seemed possible to use a portion of the bone as a graft to replace the femoral head. The writer hopes by this operation to reduce the period of treatment of tuberculous hip-joint disease from three or more years (by brace or plaster treatment) to four or five months, with less atrophy and deformity. In osteitis of the shoulder transplantation of the astragalus may be useful. The half-destroyed head of the femur was bound down by strong adhesions and was freed and removed, being sawed off in the middle of the neck. An ivory pin, 1 inch long, and $\frac{3}{16}$ inch in diameter, threaded its whole length, was then screwed into the stump of the neck and the semi-spherical piece of astragalus was screwed down hard on to the cut end of the femur, and, secured in this way, the parts held firmly. The newly formed head was replaced in the acetabulum, the wound was closed, and the leg was put up in a long plaster spica.

The subsequent history was uneventful. At the end of 10 weeks the graft was found united with about 30 degrees of voluntary motion. Roberts (Jour. Amer. Med. Assoc., Oct. 19, 1912).

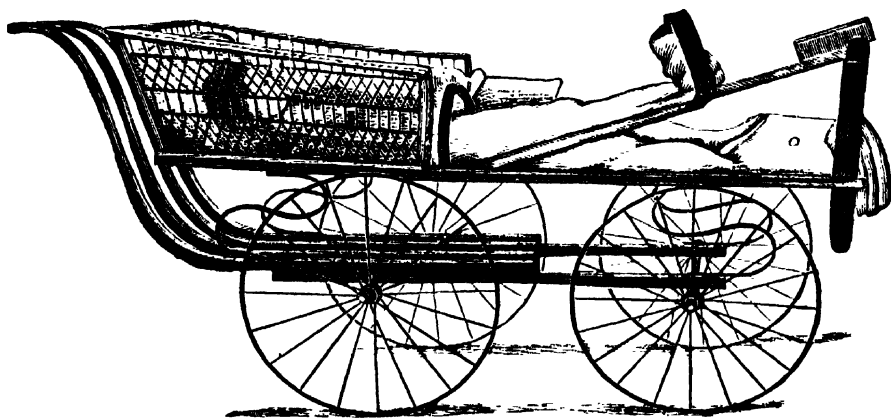
In 2 cases of tuberculous coxitis the writer, to combat the demineral-

ization shown by fluoroscopy, introduced a **bone and periosteum implant**. A bar of bone tissue, taken from the tibia, was driven through the neck, head and cotyloid bone. Radiograms of the cases taken 4 years later testified to the favorable and definite results obtained. Maragliano (Riforma Medica, May 17, 1919).

In case operation is decided upon, if the patient has a large abscess and is very much exhausted, it is usually better to **open the abscess freely** and **wash it out** at one sitting, and in a few days, when the patient has rallied from the removal of retained pus, to complete the **clearing away of dead bone**. Except in cases presenting many old sinuses, where it sometimes is best to unite these by an incision, the best method of reaching the joint is by an incision starting midway between the anterosuperior spine of the ilium and the greater trochanter, and, passing over the great trochanter, down the thigh along its outer aspect. This incision should pass completely through the periosteum and extend to a point below the lesser trochanter. By means of a curved bistoury the periosteum should now be divided at right angles to the original cut and, by means of a periosteal elevator, peeled up from the femur. At the digital fossa it will be necessary to resort to the knife to divide the muscles inserted there. At all other points the periosteum can be peeled off by the periosteal elevator. The **femur** should be sawed just above the lesser trochanter, and the **head removed** from the socket by means of a pair of lion forceps, or may be dislocated from the acetabulum prior to sawing, at the pleasure of the operator. If there are evidences of disease farther down the

shaft of the femur the periosteum must be split lower and the femur sawed in two lower down. The acetabulum should then be explored, and, if any foci of disease exist, they should be carefully removed with a sharp spoon. If the acetabulum is perforated, the opening must be enlarged so that no shoulder of bone shall cause pus to accumulate in the pelvis. Sometimes it is necessary to **drain** such **intrapelvic abscesses** through the **sciatic notch** instead of

limb is then fastened to the footboard of the cuirass by means of adhesive pieces extending to the thigh, as for the application of a hip-splint, and the footboard is then drawn down until both legs are of the same length, the bandages just mentioned as passing between the legs keeping the trunk from slipping down. The patient can be dressed in his cuirass, which is cut away under the buttock for this purpose, with much less pain than in any other manner, and can



Light carriage for cases in which recumbency is unavoidable. (*Bremner.*)

the acetabulum. If any **sinuses** exist, they should be **carefully cleaned** and all **tuberculous tissue removed** as far as possible. The **wound** should then be thoroughly **packed** from the bottom with **balsam-of-Peru gauze** and the patient placed in a wire cuirass. The **wire cuirass** consists of a wire framework extending from the head to the heels, with a pair of movable foot-pieces, which allow the legs to be lengthened or shortened. The **sound leg and the trunk** are firmly **bandaged in position** by a roller bandage. Turns of the bandage also pass over cotton pads in the groin and around the handles of the cuirass and serve to **give countertraction**. The diseased

have the benefit of outdoor life from the time of operation, being transported in a wheeled carriage.

If a cuirass cannot be had, a **double Thomas hip-splint** will answer the purpose if **combined with traction** by weight and pulley. The wound should be dressed as frequently as may be necessary to keep it clean, the packing gradually being removed as new bone regenerates from the inner surface of the periosteum, and in some cases nature will form an artificial joint almost as perfect as its fellow, although this is not to be expected, and a certain amount of shortening and more or less disability usually result.

Cases of double hip disease must be treated by **rest in bed** or by the use of the **cuirass**, as it is not possible to apply an apparatus which will allow them to walk in a convenient manner and still protect the joint.

The same rules apply to the adult as to the child, but are more difficult to put into practice and often bed treatment is better than an ambulatory splint, but, if possible, this **bed treatment** should be **out of doors**. This holds true of all bed treatment.

In exceptional cases **amputation at the hip-joint** may be a necessity to save life, but this is most uncommon, recovery with a most excellent joint on which the patient walks well having been reported by J. C. Spencer after removal of 9 inches of femur.

If amputation is done, Fernel's method should be employed.

REGINALD H. SAYRE,
New York.

JUNIPER.—Juniper consists of the fruit (berries) of the *Juniperus communis*, of the family Coniferae, a small evergreen tree of Europe, North America, northern Africa, and Asia. The berries are about $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, dark brown or purplish in color, possess a sweet and resinous taste, and contain 0.5 to 2 per cent. of a volatile oil, upon which their medicinal effects chiefly depend, a non-crystallizable principle (juniperin), a resin, from 15 to 30 per cent. of dextrose, etc. The volatile oil also exists in the leaves and other parts of the plant, and by first bruising and then macerating them in alcohol or spirit the liquor commonly known as gin is produced. The oil of juniper obtained from the wood is inferior to that distilled from the berries, which is the official form of oil from which the spirit and compound spirit are made. The compound spirit is the pharmacopeial substitute for gin and is to be preferred to the latter, which is frequently adulterated with oil of turpentine.

Oleum cadinum, U. S. P. (oil of cade; juniper-tar oil), obtained by destructive distillation from the wood of *Juniperus oxycedrus*, is a thick, brown, empyreumatic oil resembling and having the odor of tar, and with an acrid, disagreeable taste. Juniper tar contains (1) hydrocarbons which form its greater part; (2) acetic acid and its homologues; (3) phenols and allied bodies, and (4) resinous substances. It is poorer in phenols than tar from the pine or aspen, and has less disinfecting power than the other tars.

PREPARATIONS AND DOSE.—*Oleum juniperi*, U. S. P. (oil of juniper), consisting of terpenes (pinene and cadinene) and juniper camphor, and occurring as a colorless, greenish, or yellow liquid with characteristic odor and aromatic, slightly bitter taste, soluble in 10 parts of alcohol and in ether. Dose, 1 to 10 minims (0.06 to 0.6 c.c.); average, 3 minims (0.2 c.c.).

Spiritus juniperi, U. S. P. (spirit of juniper), made by mixing 1 part by volume of oil of juniper with 19 parts of alcohol. Dose, $\frac{1}{2}$ to 1 fluidram (2 to 4 c.c.).

Spiritus juniperi compositus, U. S. P. (compound spirit of juniper; gin), a mixture of 8 parts by volume of oil of juniper, 1 part each of the oils of caraway and fennel, 1400 parts of alcohol, and water, enough to make 2000 parts. Dose, 1 to 4 fluidrams (4 to 15 c.c.).

An infusion of juniper, made from 2 drams to 1 ounce (8 to 30 Gm.) of juniper berries, in 1 pint (500 c.c.) of water, is also sometimes used, the entire amount being administered in twenty-four hours in divided doses.

PHYSIOLOGICAL ACTION.—The diuretic action of juniper is due to a stimulating effect upon the renal structures, which may reach irritation when the drug is administered in excessive doses. Anuria may thus be induced. These effects are produced by the volatile oil, which, first absorbed into the general system, is then eliminated through the kidneys. The oil also exerts a stimulating action upon the gastrointestinal tract.

POISONING.—In overdose juniper produces an irritant action on the gastrointestinal canal and upon the genitourinary tract. Its action upon the latter may result in strangury, priapism, hematuria, sup-

pression, and uremic intoxication. A violet-like odor may be detected in the urine. A rash like that following the use of copaiiba is sometimes noticed.

Treatment of Poisoning.—If the patient is seen early, the stomach should be washed out through a **stomach-tube**, and **diluent** and **demulcent drinks** used freely. Administration of an **enema of laudanum**, or of **morphine** by hypodermic injection, will relieve the earlier symptoms, while **stimulants** will avert collapse.

THERAPEUTICS.—As a stimulant and antiseptic to the genitourinary tract juniper has long been considered of value. It is especially indicated in chronic disorders, such as **chronic nephritis**, **chronic pyelitis**, and **chronic catarrhal cystitis**. Active acute inflammation contraindicates its use. In the later stage of **scarlatinal nephritis**, when reaction has set in and the renal secretory apparatus is in an atonic condition, it may be of considerable service. It is a very serviceable remedy in various forms of **dropsy**. An infusion of the berries (1 ounce to the pint—30 Gm. to 500 c.c.—of boiling water), with the addition of ½ ounce (15 Gm.) of potassium bitartrate, may be given daily with benefit in chronic Bright's disease; it tends to relieve the edema and effusions incident to that disorder.

The following diuretic combination is advised by Debove, Pouchet, and Sallard:

℞ *Olei juniperi* gtt. xxx.

Extract of juniper berries,

Oxytellis scilla

(N. F.)ãã ʒiiss (10 Gm.).

Alcoholis diluti ʒiiss (100 Gm.).

Syrupi aurantii ʒiij (90 Gm.).

M. Sig.: Two to three tablespoonfuls a day.

As a diuretic agent for young children, Vogel has strongly recommended 2 to 3 teaspoonfuls of the juice of juniper berries.

Juniper preparations will give relief in the lumbar pain, or sensation of weight across the lumbar region, so frequently experienced by aged persons, in periods of diminished renal activity due to subacute congestion of these organs. **Prostatorrhoea** and the purulent discharge of **gonorrhoea** in its later stages are generally benefited by the use of juniper in moderate doses.

In **gastrointestinal disorders** juniper is valuable in small doses as a stomachic and digestive tonic. A few drops of the compound spirit in hot water will relieve the **flatulence** and pain of **infantile colic**. Gin is a favorite domestic remedy for pain associated with **menstrual disorders**. A few teaspoonfuls of it in hot water, combined with the external application of heat, frequently give prompt relief. Externally, the oil of juniper, diluted with some bland oil, may be used as a liniment. S.

K

KALA-AZAR. —SYNONYMS.—Dum-dum fever; kaladukh; non-malarial remittent fever; cachectic fever; Black-town fever; black fever; death fever; black sickness; sarkari; saheb disease, and burdwan.

DEFINITION.—A subacute or chronic specific febrile disease caused by *Leishmania donovani* and probably transmitted by means of mosquitoes (anopheles), Indian bedbugs, and possibly by other biting insects. The parasite is a minute organism, one-fourth to one-eighth the size of a red blood-cell, oval in form, having two nuclei, one large and rounded,

the other small, linear, and generally lying at right angles to the larger.

SYMPTOMS.—The period of incubation varies from ten days to several months. At the onset there is usually a rigor (which may be repeated daily), followed by an irregular, high fever, which shows two remissions daily. This double remission is pathognomonic of the disease (Rogers). The temperature declines after three to six weeks of the fever, marking the termination of the initial stage. In this initial stage the spleen and often the liver are swollen, painful, and tender. Slight headache may be present. The

bowels are unaffected. There is little or no nausea, vomiting, or abdominal distention. The pulse is usually unchanged.

The attack may begin with a continuous fever, exhibiting 2 remissions in the 24 hours; in other cases gastro-intestinal or dysenteric symptoms mark the onset; in still other cases, without any marked initial symptoms, the patients may gradually develop an enlarged spleen and liver, anemia, and weakness.

After the initial stage an apyretic interval occurs, which lasts several weeks, and ends in an attack of fever similar to that of the onset. Periods of pyrexia and apyrexia alternate, the spleen, and sometimes the liver, becoming enlarged. Increasing anemia is noted and is accompanied by progressive asthenia, the patient becoming emaciated and his abdomen swollen and protuberant. Hemorrhages from the nose, gums, stomach, and bowels, or beneath the skin, may appear. The patient may die of asthenia or from one of several complications, among which are septic infections (pneumonia, phthisis, pleurisy, meningitis), abdominal troubles (diarrhea, dysentery, cystitis), purpura, and cerebral or other hemorrhages.

TREATMENT.—The prime indication is to destroy the parasite. Manson reports 2 cures from intramuscular injections of **atoxyl** in doses of 3 grains (0.2 Gm.), given every day or two. Rogers advises giving from 60 to 90 grains (4 to 6 Gm.) of **quinine** daily until the temperature falls or becomes of a low, intermittent type, and then 20 grains (1.3 Gm.) every morning. Castellani gives 30 grains (2 Gm.) each of **quinine sulphate** and **euquinine** daily by the mouth, together with daily intramuscular injections of 15 grains (1 Gm.) of **quinine hydrochloride**, alternating with 4 grains (0.25 Gm.) of **quinine cacodylate**.

Rogers has advised the use of a **staphylococcal vaccine**. Salvarsan has been tried, but with scant success. **Red bone-marrow** has been given, to counteract the anemia.

As a prophylactic measure the **destruction of the bedbugs** in the infected houses, according to Rogers, has given most encouraging results.

The intravenous use of **tartar emetic** is the best treatment at any stage, but it should not be pushed to a dangerous extent. Care should be taken to avoid too long large doses after disappearance of the parasite. Kundu (Indian Med. Gaz., Feb., 1920). W.

KAOLIN.—Kaolin (kaolinum), also known as pipe clay, porcelain clay, china clay, or fullers' earth, is a native aluminum silicate consisting principally of the pure silicate, pulverized and free from gritty particles by elutriation. It is found in large masses in the earth, resulting from the weathering action of carbon dioxide and water on feldspar or potassium aluminum silicate. Through this action potassium silicate is formed and carried off by the rain water to serve as food for plants, the insoluble kaolin remaining. Before use it is treated with 5 per cent. hydrochloric acid to remove any lime that may be present, and is then levigated to remove sand and other foreign matter. This purified kaolin occurs in lumps or as a soft, white powder, odorless, but having an earthy taste. It is insoluble in water and in cold dilute acids and alkalis. When it is moistened with water, its color becomes darker and it acquires a marked odor of clay.

PREPARATIONS.—*Kaolinum*, N. F. (kaolin) [$\text{H}_2\text{Al}_2\text{Si}_2\text{O}_8 + \text{H}_2\text{O}$].

Cataplasma kaolini, N. F. (cataplasm of kaolin). This consists of kaolin, 577 parts; boric acid, 45 parts; thymol, $\frac{1}{2}$ part; methyl salicylate, 2 parts; oil of peppermint, $\frac{1}{2}$ part, and glycerin, 375 parts.

THERAPEUTICS.—Kaolin is a reliable aseptic dusting powder for wounds and ulcers. Richter ascribes its beneficent action to the production of a leucotaxis. An emigration of leucocytes is presumed to take place from the blood-vessels toward the deposit of kaolin wherever the surface is broken, with resulting formation of "laudable pus," the leucocytes bringing out with them the microbes from the deeper tissues. This effect is brought about by the mechanical irritation caused by the minute spicula of kaolin, which will not perforate normal

epithelium, yet wound the softer membrane of other cells.

Internally, kaolin has been used as an excipient or diluent for silver nitrate and potassium permanganate. It has been employed with good results in various gastroenteric disorders—**enteritis**, **meteorism**, **foul eructations** from the stomach, **gastric hyperacidity**, and **chronic urethritis** due to gonococci or to mixed infection. It acts here, also, as a mild mechanical irritant. It must be given in very large doses. It mechanically prevents the bacteria from receiving any pabulum as soon as they have become enveloped by it.

Cataplasma kaolini is a useful external application in **pneumonia**, **pleurisy**, **bronchitis**, **peritonitis**, etc. It is also frequently an efficient application in superficial inflammations, **mastitis**, **orchitis**, **synovitis**, **periostitis**, **boils**, and **sprains**. It replaces and is an improvement on the old-time flaxseed and mustard poultices, stupes, liniments, and other counterirritants. Its beneficial action is due to the hygroscopic power of the contained glycerin, as well as to its heat-retaining properties and to the fact that it induces superficial hyperemia, thereby relieving the congestion and pain of **deep-seated inflammations**. Cataplasma kaolini should be applied as hot as it can be borne. By immersing the container in hot water, it may be brought to the desired temperature. It should be freely spread upon the affected surface and covered with a thick layer of absorbent cotton, retained by bandages. W.

KIDNEYS, DISEASES OF. (See also NEPHRITIS.)

ACTIVE HYPEREMIA.

SYNONYMS.—Acute congestion of the kidneys; active renal congestion.

DEFINITION.—Acute transitory engorgement of the red blood-vessels, with little or no exudation.

SYMPTOMS.—The lumbar region may be the seat of a dull pain, with accompanying slight febrile movement and acceleration of the pulse.

The urine may be scanty, or if the congestion is severe there may be complete suppression. It is dark in color, of somewhat higher specific gravity than normal, and usually contains free blood, a trace of albumin, and a few hyaline casts.

Active renal hyperemia is differentiated from acute nephritis by the small amount of albumin present, the small number and character of the casts, and the absence of edema and of uremic symptoms.

ETIOLOGY.—Active hyperemia of the kidneys may be caused by sudden exposure to cold when the body is overheated, or, more generally, to the action of irritants circulating in the blood, such as the stimulating diuretics or various other drugs (cantharides, turpentine, squill, copaiba, potassium chlorate, phenol or its preparations, and corrosive sublimate). Postoperative hyperemia is common. Unilateral hyperemia may follow nephrectomy of the kidney on the opposite side, or obstruction of the ureter of the opposite kidney by a clot, calculus, twist, or bend. Prolonged congestion induces acute nephritis.

PATHOLOGY.—On examination the kidney is found to be more or less swollen, dark red in color, and engorged with blood, which exudes freely when the kidney is opened. A cloudy swelling of the epithelia of the cortex is revealed on microscopic examination.

PROGNOSIS.—The prognosis is good if the cause is removed. Repeated attacks of hyperemia, however, induce acute nephritis.

TREATMENT.—**Absolute rest in bed** and a **bland liquid diet** are essential. **Mucilaginous drinks**, **water**, and

other diluents should be used freely. The securing of free action of the bowels by means of **saline laxatives**, and the use of the **hot-air bath** or **hot pack** to promote active diaphoresis, are beneficial. **Dry cups** applied over the loin and the use of **hot fomentations** are likewise valuable. **Bier's hyperemia** in its varied forms is clearly indicated in these cases.

PASSIVE HYPEREMIA.

SYNONYMS.—Chronic congestion of the kidneys; passive renal congestion.

DEFINITION.—Chronic venous engorgement of the blood-vessels of the kidneys, generally secondary in character, and due to diseases of other viscera.

SYMPTOMS.—In addition to the edema of the lower extremities due to the general venous congestion produced by the primary disease, there may be a feeling of heaviness in the loins. The urine, diminished in quantity, is dark, of rather high specific gravity, and contains a small amount of albumin, a few blood-corpuscles, hyaline casts, and epithelial cells, the quantity varying with the chronicity and the intensity of the congestion. The urine on standing may deposit urates.

Active renal hyperemia is differentiated from nephritis by the comparative absence of albumin, casts, general dropsy, and of uremic symptoms, and by the presence of a normal amount of urea.

ETIOLOGY.—Passive hyperemia is most often a feature of the general venous engorgement incident to chronic cardiac disease (mitral disease with broken compensation of the heart); chronic pulmonary disease

(**emphysema**, **fibroid pneumonia**, **chronic adhesive pleurisy**), or chronic hepatic disease (**cirrhosis**). It may also be caused by the presence of tumors, the pregnant uterus, and ascites, making pressure upon the renal veins. Nephroptosis and kyphosis may be etiologically active by their pressure effects. As rare causes we may mention thrombosis or embolism of the ascending vena cava or of the renal veins.

PATHOLOGY.—In the early stage of passive hyperemia the kidneys are enlarged, firm, and of a dark, bluish-red color. The capsule usually is not adherent. When the kidney is opened the medullary portion appears darker than the cortex and coarsely fibrous. On microscopic examination the capillaries (glomerular and medullary) are found to be somewhat dilated and their walls thickened. The epithelia may be normal, slightly cloudy and swollen, or fatty, according to the stage of the disease. There may be a slight hypertrophy of the interstitial connective tissue. In long-standing cases the kidneys are in a characteristic condition known as "cyanotic induration."

PROGNOSIS.—This is largely dependent upon the primary disease, and upon the functional activity of the heart. Chronic hyperemia may readily induce chronic nephritis with fluctuating oliguria and albuminuria, the functional cardiac activity largely influencing these latter.

TREATMENT.—The measures indicated are **rest**, a **light** and **easily assimilable diet**, **diuretics**, and **cardiac tonics**. As examples of these groups of remedies **digitalis** and **Basham's mixture** (liquor ferri et ammonii acetatis, U. S. P.) may be mentioned.

In the treatment of congestion of the kidney measures to restore the balance in the cardiovascular system, with restriction to a **milk diet**, or, better still, to a **salt-free diet**, supplemented by **diuretics**, according to individual indications, are important. J. M. Gesteira (Brazil Medico, Mar. 15, 1912).

EMBOLIC INFARCTS.

Anemic and hemorrhagic infarcts of the kidneys are, from a pathological standpoint, of considerable interest. Their clinical significance is slight. The embolic, contracted kidney is produced by cicatrices formed by these infarcts. This condition does not always make its presence known by symptoms except in very rare cases, when the sudden appearance of a small amount of blood in the urine, in a patient with cardiac disease associated with tenderness over the kidney and, perhaps, sudden, severe pain in the loin, may indicate a hemorrhagic infarct.

The lesions which have been found are frequently unilateral, fairly characteristic, but by no means uniform in character or extent. Infarctions, red and white, single and multiple, have all been described, singly or in combination. Brewer first called attention to their comparative frequency. Brewer's cases, most of them of the severe septic type, with multiple scattered abscesses throughout the cortex, and with a clinical picture of profound sepsis, showed the wisdom of radical measures, viz.: **nephrectomy**, in this variety. Cobb, and later Cotton, called attention to milder types of infection and the results obtainable from conservative measures. L. W. Hotchkiss (Annals of Surg., Aug., 1913).

PYELITIS, PYELONEPHRITIS, AND PYONEPHROSIS.

DEFINITION.—By *pyelitis* is meant inflammation of the pelvis of

the kidney. Concomitant inflammation of the renal substance justifies the term *pyelonephritis*, and intense and extensive purulent involvement, the term *pyonephrosis*.

SYMPTOMS.—These are frequently overshadowed by those of the primary condition that causes the *pyelitis*; they are varied, also, for the same reason. The simple catarrhal *pyelitis* may cause slight pain and tenderness in the region of the affected kidney or kidneys, mild fever, with a turbid urine of acid reaction, showing a few pus-cells, a little mucus, rarely some red corpuscles, and perhaps a trace of albumin.

In the severer varieties, as in calculous *pyelitis*, the occasional concomitant attacks of renal colic are attended with the presence of blood and pus in the urine, with some mucus, and the transitional caudate epithelial cells from the middle layers of the mucosa of the renal pelvis. The presence of the latter, however, is not constant; hence their absence does not exclude the existence of a *pyelitis*, since some of the most destructive forms of the affection, as the acute or chronic suppurative or the *pyelonephritic*, may be unaccompanied by the presence of the pelvic epithelium in the urine. This holds true still more in the case of *pyonephrosis*, in which the kidney often becomes one large abscess.

In severe *pyelitis* the pain is very acute, coursing down the ureters. The fever is moderate, and most of the symptoms common to *nephrolithiasis* are manifested.

In *pyonephrosis* and *pyelonephritis* the fever is rather hectic or typhoid in type. Paroxysms of rigors or chills, followed by a rapid rise of

temperature to 104° or 105° F. (40° to 40.5° C.), and ending in profuse and exhausting perspiration, may be observed; or, there may be marked prostration, dryness of tongue and skin, feebleness of pulse, stupor, and delirium. Pyemic cases reveal a temperature curve of irregular course, with marked remissions.

In obstructive pyelitis the urine sometimes flows freely and normally for awhile, until the increasing pain over the affected kidney ends in relief by the expulsion of the obstacle and the passage of purulent urine. This *alternation* of normal with purulent urine is indicative of a unilateral pyelitis.

The urine is *ammoniacal* in cystopyelitis. Albuminuria is shown according to the degree of pyuria and associated nephritis.

In chronic suppurative pyelitis or pyelonephritis the pyuria is variable, both in quantity and constancy. Intermittent pyuria may be due to the temporary blocking of the ureter by a stone (obstructive pyelitis). The pus is seldom mixed with epithelium in chronic purulent pyelitis. The associated intermittent fever may be like that of tuberculous pyelitis, and marked prostration, anemia, and emaciation are concomitants. Evidences of amyloid change may be revealed in long-standing chronic cases.

The term *ammoniemia* has been applied to that complexus of nervous symptoms that is supposed to arise from the decomposition and absorption of urinary substances. These symptoms may be similar to the manifestations of diabetic coma.

Distinct enlargement and fluctuation in the lumbar region may be determined in many cases of pyone-

phrosis. This may also be intermittent, being detectable while there is obstruction to the flow of pus and *vice versa*. According to A. H. Smith, at the menstrual periods pyelitis may be subject to marked exacerbations simulating renal colic.

In chronic pyelitis with progressive atrophy of the kidney uremia is likely to terminate the case.

DIAGNOSIS.—Besides excluding other affections that might be confounded with pyelitis, it is important to attend to the history of the case with a view to the discovery of the cause; the urinary findings must also be studied carefully. The very nature of this affection makes it often most difficult to exclude other affections of the urinary tract, as nephritis, cystitis, and urethritis. Any severe inflammation of the tract in which the lower portion is known to be affected is generally associated with pyelitis or pyelonephritis, from the well-known tendency to extension by continuity.

Epithelium from the pelvis of the kidney cannot well be distinguished from transitional bladder-cells; but given the indications of a pyelitis, its calculous cause is at once made clear upon the passage of the characteristic uratic or oxalatic concretions. It may happen that the urine from one kidney is prevented from flowing by the impaction of a stone in the ureter. The urine may now flow clear from the other and vicariously acting kidney until, the stone having given way, it suddenly increases in quantity and changes in character, owing to the return of the morphological elements of the pyelitis (corpuseles, desquamated epithelium, crystals, and *débris*).

Catheterization of the ureters and

renal pelves, particularly in women, as described and practised by Pawlik and Kelly, is a certain method of determining from which side the purulent urine flows. Palpation of the ureters through the vagina will sometimes reveal thickening and tenderness in cystopyelitis, and ureteral distention may sometimes be felt in pyelitis calculosa.

Vierordt mentions having seen in some cases of pyelonephritis peculiar hyaline casts "split like a pair of trousers." Casts and albumin are usually present when the kidney-structure is involved by extension of the pyelitis, while marked pain in the region of the kidney indicates predominant pyelitis, though it does not exclude the possibility of coexisting nephritis. Marked vesical irritability points to associated cystitis; but in intense pyelitis with much pus and an acid urine, vesical tenesmus may also be troublesome. Tuberculous can be discriminated from calculous pyelitis, possibly, only by a consideration of the history and general condition, and by the detection of tubercle bacilli in the pus. The presence of a fluctuating tumor in the lumbar region is significant enough of pus, but it is very difficult to determine whether it is due to pyonephrosis or perinephric abscess; the history, pyuria, and less edematous overlying tissues of the former are important distinguishing points.

The *hemorrhagic pyelitis* of Senator, Delafield, and others, described as occurring in milder forms, and particularly in girls of neurotic types, may be revealed by the intermittent hematuria and occasional lumbar pain, lasting but a few days or a week, and followed uniformly by recovery.

Digestive disturbances may be prominent in these cases.

Much difficulty is sometimes experienced in diagnosing pyelitis when coexistent with cystitis—*pyelocystitis*. It should be recollected that their histories differ, pain in the lumbar region being present in the former and in the bladder in the latter; acid pus is usually characteristic of pyelitis. Great importance attaches to the relation of the albumin contents, which is from two to three times greater with pyelitis.

Of 47 cases of pyelitis, 21 had been treated for malaria. In about half the cases of pyelitis the diagnosis can be made from local signs indicating kidney trouble, but in the other 50 per cent. neither the history nor a thorough physical examination suggests an infection of the genito-urinary tract. Pyelitis is the cause of many unexplained fevers. Pyelitis of the pseudomalarial type may be divided into two groups—acute and chronic. The acute cases may be of short duration or last for weeks while the patient is being dosed with quinine. The chronic cases are not so frankly septic, but give rise to periodic aching of the limbs, chilly feelings, night sweats, etc. The urinary findings may be insignificant and catheterization is absolutely necessary in women to avoid contaminating cellular elements from the external genitalia. The real difficulty is excluding pulmonary tuberculosis, always suggested by the history. The diagnosis depends on the cellular elements in the urinary sediment, with the constitutional symptoms. D. Vanderhoof (Jour. Amer. Med. Assoc., Apr. 20, 1912).

With the patient sitting erect, but relaxed, lightly palpate the lumbar muscles. If one kidney is the seat of an inflammatory process, the muscles on that side will feel firmer than normally. Pottenger (Jour. Amer. Med. Assoc., Mar. 29, 1913).

The blood count has no distinctive value, a leukocytosis of 10,000 being as inefficient as to diagnostic value as one of 20,000. In no instance was it possible to differentiate draining mild urinary infections from closed collections of pus. Roth (Calif. State Jour. of Med., Jan., 1921).

ETIOLOGY.—The causes of pyelitis are practically of secondary origin. They are mainly as follows: (1) renal calculi [the most frequent]; (2) urethritis, cystitis, or ureteritis extending upward; (3) retention of decomposed urine in the pelvis of the kidney; (4) renal affections, or tubercle, carcinoma, and acute nephritis; (5) specific fevers, including influenza, perhaps; (6) other foreign bodies than stones; (7) irritating diuretics. Regarding the cause first mentioned, it should be pointed out that calculous pyelitis may result from the irritation of the constant presence and passage of small stones ("gravel"), or even of uric acid "sand," as well as from the large dendritic concretions that send offshoots into the calyces. Extensions of inflammation to the pelvis from lower portions of the urinary tract may occur in protracted cases of such affections as gonorrheal urethritis and puerperal and calculous cystitis. Obstructive pyelitis sometimes follows the impaction of renal calculi or of other foreign bodies in the ureter when there is pre-existing inflammation of the tract or when, as usually happens, there is chemical irritation from the decomposition of the accumulated urine. There may be obstruction in the bladder and urethra, as from enlarged prostate, stricture, or phimosis. When pyelitis is primary in origin it is due to exposure to wet and cold.

The literature of gonorrheal pyelitis includes only about 20 cases. The special features are the insidious onset without symptoms referable to the kidney; the severity and duration of the posterior urethritis and cystitis, and a lack of fever and toxic symptoms.

The infection, though severe, was confined to the urinary mucosa without involving the deeper structures. L. C. Lehr (Jour. Amer. Med. Assoc., July 6, 1912).

Infection by the colon bacillus is most common, direct transmission through the intestinal walls being the probable mode of entrance. O'Connor (Boston Med. and Surg. Jour., Nov. 7, 1912).

Pyelitis is not infrequent in pregnancy and the puerperium (*pyelitis gravidarum*). The cause in these cases may be either pressure on one or both ureters by the pregnant uterus, or bacterial infection of the urinary tract, as by *B. coli*, the gonococcus, pyogenic organisms, or the tubercle bacillus. Traumatism and lowered general vitality are also possible etiological factors. The condition appears to be slightly more frequent in primiparae, and begins, usually, either in an insidious or stormy manner, from the fifth to the eighth month of pregnancy (Chase).

Pyelitis is common in newly married women. The recognition of defloration and coitus as causes of pyelitis is most important, as it relieves both the physician and the husband of the embarrassment which a diagnosis of gonorrhea often causes. When urinary antiseptics fail to cure the condition early, local treatment should be employed. Even slight symptoms of cystitis in newly married women should not be ignored, for they may be the starting point of *pyelitis gravidarum*. Wildbolz (Corresp. Blatt. f. schweizer Aertze, Jan. 1, 1912).

Pyelitis is also a not uncommon condition in children, being typically preceded by an acute infection, oftenest influenza. Still reports that 23 out of 26 of his cases in children under 1 year of age were in females. These children often became suddenly cold, blue, and collapsed. Straining or discomfort in, or frequency of, micturition was rarely present.

Whooping-cough, scarlet fever, and megacolon are particularly liable to entail pyelocystitis in children. The clinical pictures vary widely. The toxic form is the most severe. The author encountered such cases among breast-fed infants during the heated term. The temperature ran up to 42° C., and unconsciousness and vomiting supervened, in some cases diarrhea. Langstein (Med. Klinik, Sept. 14, 1913).

In the pyelocystitis of infancy the symptoms as a rule do not point to the urinary tract. The onset is usually sudden with high and persistent rise of temperature and little else. The urine shows a distinct bacilluria. Within 24 to 72 hours pus makes its appearance. The colon bacillus is the most frequent causative factor. Grulee. (Northwest Med., xvii, 82, 1918).

Infectious pyelitis may result from small-pox; diphtheria; typhus, scarlet, and typhoid fevers, and is probably produced by the toxic substances eliminated. Nephritis is commonly associated with it (pyelonephritis). Parasites—such as the echinococcus, distoma, strongylus, and filaria—may give rise to pyelitis.

Cantharides, cubebs, copaiba, turpentine, etc., and diabetic urine even may in rare instances excite this affection.

PATHOLOGY.—The morbid changes in the simple catarrhal variety of pyelitis consist of a con-

gested, swelled, and sometimes ecchymotic, mucous membrane covered with a viscid, smooth exudation of mucopus and desquamated epithelium. The urine in the pelvis of the kidney is turbid from the admixture of pus-corpuscles and epithelium. In calculous pyelitis, owing to prolonged and severe irritation, purulent inflammation and ulceration prevail, and the renal structure is also involved by extension (*pyelonephritis*). Renal abscesses are thus formed, and small, dark calculi are found frequently, mingled with the pus in numerous small abscess cavities, or, perhaps, the destroyed renal parenchyma may be entirely replaced by one large abscess (*pyonephrosis*).

A diphtheritic inflammation, with the formation of a false membrane and sloughing of the pelvis, sometimes follows the severe infection of the specific fevers. Marked hemorrhagic areas may also be seen. In tuberculous pyelitis there is usually associated a nephritis with areas of tuberculous softening and ulceration, and later pyonephrosis. In certain chronic cases of pyelitis there may be cheesy masses of infiltration affecting the kidney-structure; calcification of these may ensue.

Persistent obstruction leading to pyelitis is associated with dilatation of the pelvis from retention of urine or pus (*pyonephrosis*). This, in turn, from prolonged pressure, causes the marked atrophy of the secreting structure of the kidney that is seen in such cases. There is also an increase in the interstitial tissue with secondary contraction.

Surgical kidney, so called, which is an acute suppurative nephritis, is the result of an acute bilateral pyelitis

due to the extension upward of a severe cystitis. Acute suppuration or interstitial inflammation of the kidney, due to metastatic or miliary abscesses, occurs as a complication of pyemia.

PROGNOSIS.—Renal complications always make the pyelitis a serious affection. Catarrhal cases recover. Calculous pyelitis tends toward chronicity. Pyelonephritis and pyonephrosis are likely to end fatally from exhaustion or uremia. Perforation and the discharge of pus into the peritoneal cavity, pleural sac, intestine, and bronchi, even, may precede death. The gravity of all cases of pyelitis depends upon the causes and upon the tendency to consecutive suppuration.

Eighteen out of 26 women with pregnancy pyelitis proceeded to term with living children; 5 others had living children born prematurely; 1 woman aborted, and 1 developed eclampsia. All recovered. These comparatively good results are ascribed to routine direct medication of the kidney pelvis, without operative measures. Weibel (*Arch. f. Gynäk.*, Bd. c, Nu. 2, 1914).

In the pyelitis of infancy and childhood there is practically no danger to life. Under appropriate treatment recovery in a few weeks is usual, though the condition may return at intervals for many months (Wyman).

TREATMENT.—This varies according to the cause: the latter needs to be removed, its effects counteracted, and its return avoided. The treatment of calculous pyelitis is essentially that of nephrolithiasis. Primary inflammation of the lower portion of the urinary tract must be combated, causes of urinary retention and decomposition must be dimin-

ished, infectious fevers must be judiciously handled, and irritating diuretics withheld.

In all forms of pyelitis local measures are useful, in the form of **hot-water bags**, **fomentations**, **dry cupping**, etc. Internally, the use of **diluents** is to be encouraged, especially the **alkaline mineral waters**, **flaxseed** and **moss teas**, **barley water**, **lemonade**, **skimmed** and **butter milk**.

In acute cases milk should constitute the chief element in the **diet**, cereals with sugar and cream, and bread and butter making up the remainder. In chronic cases a diet similar to that appropriate in chronic nephritis should be prescribed, all **condiments**, **rich articles**, **preserved meats**, and other renal irritants being **prohibited**. **Copious water drinking** is usually to be recommended. **Alcoholic beverages must be given up**.

A complete transformation may follow suddenly on ordering a **copious intake of water** in the pyelitis of children, even when uremic symptoms are pronounced. Langstein (*Med. Klinik*, Sept. 14, 1913).

Among drugs selected for their soothing properties are **potassium citrate**, **uva ursi**, and **buchu**. Altering the reaction of the urine from acid to alkaline with **potassium acetate** or **bitartrate**, or from alkaline to acid with **sodium benzoate** or **salicylate**, may prove of value by providing a less favorable medium for the propagation of the bacteria present (Meara). In the event of suppuration **surgical intervention** is necessary. **Irrigation** by means of **Kelly's ureteral catheter** may be practised with good results in females suffering from purulent pyelitis. **Operation through the back** is usually

indicated in pyelonephritis and pyonephrosis. In chronic pyelitis such locally stimulating or antiseptic drugs as **phenyl salicylate**, **hexamethylenamine**, **methylene blue**, and the oils of **turpentine**, **sandalwood**, **juniper**, **copaiba**, and **erigeron** may be tried.

Satisfactory results in pyelitis gravidarum from assumption of the **sitting posture**, thus favoring drainage of the renal pelvis into the bladder. P. M. Pilcher (Surg., Gynec. and Obstet., Feb., 1910).

According to Opitz, pyelitis of pregnancy is due to compression of the right ureter by the enlarged uterus. The writer observed 2 cases in which the condition was cured by the simple method of **lying on the left side**. The symptoms and urine cleared up within two weeks. N. Markus (Berl. klin. Woch., Apr. 24, 1911).

Alkalinization of the urine with **potassium citrate** recommended in pyelitis of children. The only gauge of efficiency of the dosage is the reaction of the urine. Eight to 10 grains (0.5 to 0.65 Gm.) every two hours for an infant and 20 (1.3 Gm.) or more grains every two hours for a child three years old are often required. If potassium citrate disturbs the digestion the alkalinization of the urine may be maintained by **potassium or sodium bicarbonate**. G. F. Still (North of England Clin. Jour., Jan., 1912).

In pyelonephritis of pregnancy pain is treated by **warm applications to the loins**, and if necessary to the abdomen, and with **tincture of hyoscyamus**, 30 minims (1.8 c.c.) t. i. d. Sometimes great relief is obtained by having the **foot of the bed raised** 1 or 2 feet, while in other cases a **sitting posture** may give relief. As a rule, the pain soon yields to treatment.

Interruption of the pregnancy should be avoided if possible, and expectant treatment always given a fair trial. If both kidneys are af-

ected, and the condition does not yield to medical treatment, and the patient's general condition is going from bad to worse, it may be necessary to **empty the uterus**. Andrews (Brit. Med. Jour., May 18, 1912).

Vaccine treatment of gonorrheal pyelitis failed. Injection of large quantities of a comparatively weak solution of **silver nitrate** gave excellent results, with the least amount of chemical or mechanical irritation. L. C. Lehr (Jour. Amer. Med. Assoc., July 6, 1912).

Alkaline treatment is often sufficient in the pyelitis of infancy and childhood. The **urine** should be **made highly alkaline**. If it does not clear up under this treatment, **hexamethylenamine** in doses of 1 to 3 grains (0.06 to 0.2 Gm.) should be used. If the urine is alkaline, it should be made acid with **sodium benzoate** or **benzoic acid**, and then tested for formaldehyde until it is shown to be present, while the dose of hexamethylenamine is increased and irritation of the kidney carefully watched for. If the trouble still continues, large doses of hexamethylenamine may be given, with **autogenous vaccines** every three or four days, beginning with 25,000,000, and increasing to 160,000,000. The large doses of hexamethylenamine should not be continued for more than a week at a time, but should then be discontinued for several days and started again at the same maximum dose.—25 grains (1.6 Gm.) daily for a child of 6 months, 25 to 45 grains (1.6 to 3 Gm.) daily for a child of from 9 to 12 months. The urine should be carefully watched for signs of renal irritation. E. T. Wyman (Boston Med. and Surg. Jour., Apr. 2, 1914).

To effectively treat pyelocystitis in infants, the infective organism should be attacked. For this purpose, large quantities of alkalies should be given. To a baby under 6 months one may give 10 grains (0.6 Gm.) of **soda bicarbonate** and 10 grains (0.6 Gm.) of

potassium citrate every 2 hours, night and day, continued from 4 to 7 days. After improvement sets in **hexamethylenamine** is given, 3 to 5 grains (0.2 to 0.3 Gm.) 6 times daily. Autogenous vaccines gave no results. C. G. Grulee (*Northwest Med.*, xvii, 82, 1918).

Bovet and Huchard recommend treatment of infectious pyelonephritis by **hypodermoclysis of normal saline solution**.

Surgical measures are indicated in severe purulent pyelitis, pyelonephritis, and pyonephrosis.

PERINEPHRIC ABSCESS.

SYNONYM.—Perinephritis.

DEFINITION.—Suppurative inflammation of the connective tissue enveloping the kidney.

SYMPTOMS.—The patient has a dull, throbbing pain over the kidney region that is increased by motion; when the abscess is large and presses on the large nerve-trunks, the pain shoots downward into the leg on the same side. There may be a sensation of numbness. Palpation of the region will usually elicit pain and tenderness. The patient becomes prostrated, weak, and often emaciated. Flexure of the thigh on the affected side is common. Fever of a marked remittent or intermittent type with alternating chills and profuse sweating is present, indicating suppuration. When the kidney is involved, pus is found in the urine. Later there is a localized swelling over the affected region and a gradual tumefaction of the lumbar area, progressing slowly, the skin becoming smooth, shiny, and edematous. In advanced cases fluctuation is frequently present, and if the case is tending to a favorable issue signs of "pointing" appear.

DIAGNOSIS.—The condition may be somewhat obscured by a tendency of the pus to burrow downward, as distinct local symptoms will in that case be absent. If the psoas is involved symptoms of coxitis will appear, and the pain will be referred to the knee-joint. The diagnosis is generally easy. In cases of doubt as to whether the swelling is an abscess, a hydronephrosis, or a solid mass an aseptic exploring needle will usually clear up the diagnosis.

X-rays aid in the diagnosis. In a case cited, fluid was shown. The shoulders were grasped and the patient's body moved quickly 2 or 3 times from side to side. The fluoroscopic picture showed a distinct wave. The renal region was opened and a huge sac of pus found on the renal capsule. Fussell and Pancoast (*Amer. Jour. Med. Sci.*, Jan., 1920).

In differentiating this condition from suppurative pyelitis or from pyelonephritis we are aided by the fact that in the latter there is a diminished secretion of urine, while in the former interference with the renal secretion less often occurs. Moreover, in the latter, blood and pus are found in the urine; in the former, however, while the urine is free from blood, pus may be present, and casts are generally absent.

ETIOLOGY.—When not produced by trauma perinephritic abscess is most often a result of purulent pyelonephritis or pyonephrosis. It is, therefore, generally secondary. It may also be due to an extension of inflammation arising in the ureter or pelvis of the kidney, pelvic, appendiceal, or hepatic abscesses, spinal caries (psoas abscess), and empyema. Perinephritic abscess may complicate tuberculous processes in the kidney

and suppurating new growths, as carcinoma and cysts (including the echinococcus). As rare causes may be mentioned severe infections as typhus fever, small-pox, and pyemia. In some cases no cause can be assigned.

PATHOLOGY.—The lax adipose tissue forming the fatty capsule in which the kidney reposes and the adjacent retroperitoneal tissue are usually the seat of the suppurative process, which usually begins posterior to the kidney. While there may be, at the start, a collection of small abscesses a single large abscess is usually found. The abscess walls are at first soft and inclined to be shreddy; later, as in the chronic cases, thick and fibrous. When the accumulation of pus is large an external bulging in the affected lumbar region may be seen. The pus has a tendency to burrow into the adjacent tissues, most frequently downward toward the iliac fossa, when it may be found pointing in the groin near Poupart's ligament. It may, however, burrow backward and discharge through the skin in the loin. More rarely the pus perforates the diaphragm and finds its way into the pleural cavity or lungs; or the abscess may rupture into the colon, vagina, bladder, or peritoneal cavity. Occasionally the pus is thin and has a very offensive odor, due to infiltrated urine. When caused by calculous pyonephrosis, calculi may be found in the abscess, having ulcerated through the walls of the kidney or its pelvis. The adjacent peritoneum often becomes thickened or hypertrophied. In rare cases, giving rise to no symptoms during life, fibrous adhesions and a firm, thickened, and fatty cap-

sule, will be found surrounding the abscess at the autopsy. This capsule may be so tough and adherent that some force is required to separate it from the proper capsule of the kidney.

PROGNOSIS.—If the abscess points externally in the lumbar region the prognosis, though favorable, should be a guarded one. It is always unfavorable if it ruptures into the peritoneal cavity, groin, bowel, or bladder.

TREATMENT.—The treatment is in all cases surgical and calls for **free incision and drainage.**

Of 36 cases collected, 25 were in males. The age of the oldest patient was 60 and of the youngest, 10. The right side was affected in 23, the left in 13. The source of infection was unknown in 20 cases, in 2 there was pyonephrosis, 2 others were probably of renal origin; there was urethral infection in 2, influenza preceded 2, 3 were possibly derived from pelvic disease, peripheral suppurations probably caused 2, and trauma was prominent in 3. Postural changes were noted in 10 cases, in the main being a tendency to flex the corresponding thigh, though in several there was some spinal curving and in 1 with sciatic pain flexion of the thigh was presented. Pulmonary phenomena were seen in 13 cases, varying from a simple cough to a fatal septic pneumonia. The urine was normal in 15 cases, practically normal in 5, having a trace of albumin with casts, etc., in 12, and showing pus in 4. The pus yielded sterile results in 2 cases, colon bacillus in 6, staphylococci in 5, *Staphylococcus aureus* in 4, *Staphylococcus albus* in 2, *Staphylococcus aureus* and *albus* in 1, streptococci in 2, and streptococci and pneumococci in 1. Thirty-five abscesses were evacuated; 1 patient declined operation and was discharged; 30 patients recovered and 5 died—a mortality of 14.3 per cent. M. B. Miller (Annals of Surg., Mar., 1910).

AMYLOID, LARDACEOUS, OR WAXY KIDNEY.

It is an open question whether this condition should be considered separately, since it is but a local manifestation of a widespread process due to various causes: syphilis, tuberculosis, etc. It also appears as the manifestation of the degenerative process of advanced Bright's disease, especially in the form following low fevers. It has already been alluded to in the article on BRIGHT'S DISEASE, Vol. I.

SYMPTOMS.—The condition itself may not present distinct clinical features. There is usually found a history of long-continued suppuration, or of syphilis; perhaps of alcohol. The urine generally gives very fairly characteristic indications. Its quantity is increased, its specific gravity is somewhat, but not greatly, diminished, varying from 1015 down to 1005. It is usually singularly clear and translucent, and on standing yields very little sediment. Under the microscope may be found a few casts, which are generally broad, hyaline, fatty, and granular. The amyloid reaction may be obtained with the hyaline casts. Serum-albumin and globulin may both be present in the urine, but a seemingly diagnostic condition, according to Salkowski and Senator, is the high proportion of globulin as compared with the serum-albumin. In later stages, when degeneration has set in, the urine becomes reduced in quantity, is mostly turbid, and then presents under the microscope the morphological signs belonging to the degenerative process. There are associated with this condition of urine anemia, debility, but not often much dropsy, with the characteristic transparent and deli-

cate complexion. There is usually degeneration of blood; often diarrhea and vomiting. Cerebral symptoms are not at all common. The arteries are usually soft, and the heart generally shows very little change. Death comes by wasting, diarrhea, inflammation, and the kindred affections of the liver and other organs (W. M. Ord).

DIAGNOSIS.—The diagnosis cannot usually be made from the urinary examinations alone. But if following syphilis, tuberculosis, or chronic bone suppuration, the urine is found to be albuminous, of low specific gravity, and increased in quantity, and the liver and spleen are enlarged, the diagnosis of amyloid disease may be made with comparative certainty.

ETIOLOGY.—Amyloid kidney is usually associated with amyloid degeneration in other organs, as the liver and spleen, as is the result of wasting diseases, tuberculosis of the lungs or intestines; syphilis, especially tertiary; chronic bone suppuration, or other chronic suppurative processes, as chronic empyema, intestinal ulcers, or vesicovaginal fistulae. It may sometimes be a sequel of gout, malaria, leukemia, cancer, or chronic valvular insufficiency.

PATHOLOGY.—Macroscopic examination shows the kidney to be firm, large, smooth, and pale, greenish or yellowish white, and the surface smooth, shiny, and often mottled when the stellate veins are prominent. The capsule is thickened, but is easily detached. Upon section the surface appears homogeneous, anemic, or "bacon-like," particularly in the cortical region, which is wider than normal; the pyramids are deep red in color and slightly infiltrated.

The Malpighian tufts, which are the parts most affected by the waxy change, are translucent. An application of Lugol's iodine solution to the amyloid areas will produce a mahogany-red color. If then a weak dilution of sulphuric acid is applied, a blue or violet tint is produced; if a 1 per cent. solution of methyl violet is used instead, a red color appears.

Accompanying this degeneration is a diffuse nephritis,—with fatty degeneration affecting the epithelium of the tubes especially,—glomerulitis, and thickening of Bowman's capsules. The advanced cases show marked atrophy of the secretory structures. The small, granular kidney is less subject to amyloid infiltration than the large, white kidney.

Cardiac hypertrophy does not always coexist with amyloid renal disease.

PROGNOSIS.—This depends to a great extent upon the disease which is the cause of the amyloid condition, but is usually very grave. In marked cases death occurs after a period varying from several weeks to several months.

TREATMENT.—The original disease is to be treated according to indications, while the kidney trouble will be best met by the remedies and general **dietetic** and **hygienic measures** used in chronic Bright's disease (*q.v.*, Volume II). **Iodide of iron** may be used for its alterative effects, and palatable and easily assimilable **fats** (cream, butter, olive oil) and **tonics** deserve trial. **Creosote** and its preparations are indicated in tuberculous cases; **mercurials** and the **iodides** in syphilitics; malarial cases improve under the use of **iron**, **arsenic**, and **quinine**.

SYPHILIS.

Syphilis of the kidney is usually a tertiary manifestation of lues, although it may appear in the secondary stage.

SYMPTOMS.—Except in amyloid degeneration of the kidney there are no proper symptoms that are pathognomonic of this condition.

A special form of renal syphilis has been described by Wagner, who calls it acute syphilitic glomerulonephritis, having hematuria as a distinctive feature, and a rapid end with uremic symptoms.

It is still uncertain whether the disease is the result of the action of toxins, or of a settlement of spirochetæ in the kidney. The serum reaction is always well marked. R. Bauer and P. Habetin (*Wiener klin. Woch.*, July 3, 1913).

The writer has found congenital syphilis of the kidneys relatively frequent at necropsies. The manifestations are sclerotic atrophy, gummas, and retention cysts. The condition is not characteristic of congenital syphilis, but in some instances occurs in an acute interstitial and parenchymatous form or as a condition of chronic sclerous atrophy. Canelli (*Pediatrics*, May, 1918).

PATHOLOGY.—Three forms of syphilitic infection of the kidney are observed: amyloid degeneration, which is the commonest form; chronic interstitial nephritis, and gumma.

TREATMENT.—The treatment is that of the primary disease (syphilis).

Cure of the syphilitic nephritis which may be superimposed upon an already impaired kidney, and is characterized by a specific alteration of the glomeruli, is best accomplished by a carefully combined **mercury** and **salvarsan** treatment. E. Hoffmann (*Deut. med. Woch.*, Feb. 20, 1913).

TUBERCULOSIS.

DEFINITION.—This may be primary or secondary, the latter being the more frequent form. It may affect one or both kidneys, but generally remains unilateral for some years before the other kidney is involved.

SYMPTOMS.—There may be either no renal symptoms or none until late in the disease, but the symptoms of pyelitis are usually present. For a considerable time pyuria may be the only symptom; this usually indicates cystitis, but with that condition vesical tenesmus and frequent micturition are associated. There is usually pain referred to the affected side, often like that of renal colic. Hematuria is not infrequently met with; indeed, it may be the initial symptom. In 203 cases Braasch found bladder irritability in 86 per cent., and hematuria in 60 per cent. Tuffier suggests the use of the cystoscope in order to trace the origin of the hematuria. Tubercle bacilli are often found in the urine, but not in the miliary form. Polyuria and albuminuria are sometimes present. The urine may also contain tube-casts, but more often pus-cells. Cheesy masses of appreciable size are occasionally seen in the urine.

When the affection becomes advanced, chills, fever of a suppurative type, emaciation, and progressive asthenia appear. An extensive lesion may exist, however, without giving rise to marked general symptoms. Tuberculous lesions, especially of the lung, are often coexistent.

The importance of this subject has been often overlooked; even Osler paid little attention to it. There are 2 types: (1) Early involvement,

which may consist in a transient albuminuria, or acute or subacute nephritis. (2) Later involvement, which may be (a) chronic interstitial and parenchymatous nephritis; (b) amyloid kidney, or (c) gumma. In the transient albuminuria of early syphilis of the kidney there is little or no symptomatology. Acute syphilitic nephritis may occur even before the skin eruption of syphilis appears, or may occur 3 years after; the average time, however, is 5 months after the infection, and it rarely occurred after the first year. The first symptom is usually edema, which may go on to general anasarca, ascites, and hydrothorax. In some instances there is pain in the lumbar region, fever, and vomiting. The most striking feature, however, is the albuminuria, there being an enormous quantity of albumin in the urine. Casts of all kinds may be present. Examined with the polariscope, double refractile lipoids are more abundant in the urine in syphilis of the kidneys than in other renal conditions. Yet renal function is less impaired. The prognosis of the early transient form is good, fairly favorable in the acute and chronic forms; unfavorable in amyloid kidney, and favorable if recognized clinically in gumma. The treatment is both specific and general. Lloyd Thompson (*Trans. Amer. Med. Assoc.; Med. Rec.*, May 8, 1920).

DIAGNOSIS.—This is easily made if tubercle bacilli can be found, or if tuberculosis of the lungs or other organs are associated with the renal trouble. The tuberculin test will aid diagnosis. Chevassu recommends the antigen reaction of Debré and Paraf. Inoculation experiments with the urine may be made on animals, but the bacilli may reach the urine from more distant parts than the kidney. Ureteral catheterization may decide which kidney is involved when hematuria is a prominent symptom. The use of the X-ray after in-

jections of 20 c.c of a 10 per cent. solution of collargol into the ureters is of diagnostic aid. From calculous pyelitis tuberculous nephritis may be differentiated by the facts that in the latter the pain is less severe, the tumor-mass smaller, and the hemorrhage less frequent.

The most prominent symptoms of renal tuberculosis are those referable to deranged bladder functions. Intermittent pyuria suggests it. Pyuria without demonstrable bacteria by smear or culture in a catheterized specimen is likewise suggestive. In the absence of mixed infection the temperature is normal or shows only a slight evening elevation. While enlargement of the diseased kidney is usually manifest on palpation, it is important to remember that compensatory hypertrophy may lead to erroneous conclusions in determining the diseased organ. Thickening of the vaginal portion of the ureter is of value in diagnosis, but by no means characteristic of tuberculous infection. The tuberculin reaction is of doubtful value. The most important diagnostic agent is the cystoscope. Only by its use can one determine the extent of disease as well as the condition of the opposite kidney.

The Bloch method of inoculation of guinea-pigs (injection in the inguinal region, after slight injury to the inguinal glands by compression) should be used. The diagnosis may thus be made in at least 77.3 per cent. of the cases in ten days, as compared to six weeks by the subcutaneous or intraperitoneal methods. Keene and Laird (*Amer. Jour. Med. Sci.*, Sept., 1913).

The diagnosis of renal tuberculosis may be simple or, on the other hand, the most difficult of all urinary lesions, often requiring preliminary treatment to allay acute symptoms and repeated cystoscopic examinations over a long period of time. The treatment cannot be outlined from a

study of the symptoms, but it is most important that the remission of symptoms, often for long periods of time, should not be accepted as a cure. The effort on the part of nature to limit the lesion should be utilized and encouraged. Bugbee (*Surg., Gynec. and Obstet.*, xxvi, 579, 1918).

ETIOLOGY.—Age and sex are prominent factors. Most cases occur in middle life, though they may occur earlier or later. Males are more frequently affected than females.

The causative agent is the tubercle bacillus, which reaches the kidneys in the blood-stream, producing primary tuberculous nephritis, through the lymphatics, and by direct extension from adjacent structures.

PATHOLOGY.—The calyces and apices of the pyramids (papillæ) are the initial location of the tubercles, from whence they extend to the pelvis of the kidney, so that pyonephrosis may be the early condition. The process then affects in turn the ureters, bladder, and prostate. In rare cases the process apparently originates in the bladder or prostate and extends upward. The tubercles, after becoming deposited in the various locations, pass through the same changes as elsewhere—caseation, necrosis, and suppuration—and in the course of these changes the renal tissue is destroyed to a greater or less extent, entailing the formation of cheesy cysts, often impregnated with lime-salts. When the bacilli reach the kidney through the blood-stream (hemogenic infection) the process may be limited to the cortex, and produce nodular tuberculosis with cheesy masses with but slight loss of the kidney tissue. It is generally conceded that the infection of the kidney is almost always hematogenous;

nevertheless, in a small number of cases renal tuberculosis is undoubtedly an ascending process. For a considerable period the disease is unilateral, though in most instances both kidneys become involved. Hallé and Motz in 132 cases found a single kidney involved in 89 cases. Disseminated tubercles in both kidneys are found in acute miliary tuberculosis, but here caseation and necrosis seldom occur.

PROGNOSIS.—Most cases of unilateral renal tuberculosis become bilateral if not suitably treated. The prognosis thus depends upon the promptness with which the condition is recognized and surgical treatment applied.

Wildbolz found that without intervention most patients with tuberculosis of the kidneys die in the course of five years. About 20 per cent. live from five to ten years, and those who live beyond ten years are very few. In a series of 168 non-operated patients the writer found that 53 per cent. had died, and 47 per cent. were living; 11.3 per cent. died the first year; 23 per cent., between the first and fifth year; 15.9 per cent., before the end of the tenth year, and but 3 per cent. lived beyond the tenth year. The average age which men live is four years and ten months, while the average that women live is five years and five months. Raffin (Jour. d'Urol., Oct., 1912).

An unusual complication of renal tuberculosis is *closed pyonephrosis* (pyonephrosis tuberculosa occlusa of Zuckerkaudl), which develops after an obliteration of the renal pelvis or ureter.

The perirenal and periurethral interstitial tissue can also be affected, and at times a cold abscess is formed along the psoas, suggesting an affection of the spine (Smirnow).

Closed pyonephrosis presents greater difficulties in certain cases for diagnosis than any other condition of the kidney. In the majority of cases there is a renal distention showing itself by a lumbar or abdominal swelling. In a smaller number there is no swelling, and the affected organ is atrophic. The cases can be divided into the following groups: 1. The bladder is tuberculous. In the region of the supposedly diseased kidney a large tumor, the pyonephrotic sac, is found. The ureter on this side is impermeable. Diagnosis is easy. 2. The bladder is normal. One ureter is impermeable and on this side there is a tumor in the kidney region. Diagnosis is possible from the history of the case, and the symptoms referable to other organs. 3. The tuberculous involvement of the bladder is far advanced and cystoscopy is impossible. An enlarged kidney can be palpated. Diagnosis is possible only by exploratory incision. The enlarged kidney may be healthy and only hypertrophied, while the other kidney is atrophic and tuberculous. H. A. Fowler (Jour. Amer. Med. Assoc., Jan. 3, 1914).

TREATMENT.—Where but one kidney is diseased, its **surgical removal** at the earliest practicable time is definitely indicated, as there is at present no evidence of a curative result from medical treatment, and the more time is lost the greater the chance that the infection will have passed to the opposite kidney or the ureter and bladder. If pus and bacteria have already been found, however, in the urine from both ureters, or where the patient with unilateral involvement refuses operation, nephrectomy is contraindicated, and medical measures will have to be depended on. (According to Hunner, where one kidney is so diseased as to be largely devoid of function while

the activity of the other is only slightly curtailed, removal of the former usually results in increased function of the latter.) The general treatment should be that appropriate for tuberculosis of the lungs, including a **generous diet** of nourishing food, **fresh air, rest, and proper hygiene**. In patients who react well **cold baths** in the form of a sponge, shower, or plunge are beneficial. **Woolen underclothing** should be worn by preference.

The writer operated in 52 out of 100 cases of tuberculosis of the kidney, with a mortality of 5 cases. In 140 operations on the kidneys the only death from renal insufficiency was in a case in which he was unable to apply beforehand the usual functional tests and catheterization of the ureters. When the elimination of sugar after the phloridzin tests and elimination of indigo carmine are notably delayed, it is doubtful whether the other kidney alone would prove equal to the task. He would not perform nephrectomy in such a case. Casper (*Deut. med. Woch.*, July 30, 1908).

As regards medication, **tuberculin** has been used by many in an attempt to cure the disease in its early stages. Previous experience in its employment and a thorough knowledge of the technique, however, are essential to its successful use, and even at best the results so far obtained hardly seem to justify any delay on this account in operable cases. Symptomatic treatment in the unoperated cases consists in controlling fever with **cold sponging**, correcting constipation or diarrhea by changing the **diet** and giving **laxatives** or **bismuth**, and preventing night-sweats by **sponging with 25 per cent. alcohol** or **diluted vinegar** and the administra-

tion of drugs such as **agaricin, camphoric acid, and atropine**. Hematuria, when observed, indicates the use of **morphine, calcium chloride or lactate, gelatin**, and the repeated injections of **horse serum**, 150 minims (10 c.c.) at a dose. In complications such as cystitis, pyelitis, paranephritic abscess, and uremia the measures described elsewhere as appropriate for these conditions should be availed of.

Five cases in which the writer used **tuberculin**, or **Spengler's immunizing bodies**, or both with ultimate success. Treatment along these lines may relieve a large number of cases hitherto thought to be exclusively surgical, and will prevent, even in surgical cases, the spread of infection to the other kidney. J. Castaigne (*Presse méd.*, Jan. 20, 1912).

Small doses of **tuberculin**, $\frac{1}{45,000}$ mg. twice weekly, advised. At times he gives but $\frac{1}{450,000}$ mg. The patient should feel better immediately after the first dose and for from 2 to 4 days; another dose should then be given. This treatment was used in conjunction with hygienic and symptomatic treatment, the duration of treatment averaging $3\frac{1}{2}$ years. Diagnosis depends principally upon microscopic examination of the urinary sediment. The tuberculous kidney should not be removed so long as it has functional value. Dillingham (*Calif. State Jour. Med.*, xv, 70, 1917).

NEPHROLITHIASIS.

SYNONYMS.—Renal calculus; renal colic; gravel; pyelitis calculosa.

DEFINITION.—A condition in which fine or coarse concretions are formed in the kidney-substance or in the pelvis of the kidney by the precipitation of solid substances from the urine.

SYMPTOMS.—Pain and hemorrhage are the most important symptoms, in case the stone is small and

the kidney healthy; indeed, these may be the only symptoms present. The pain is usually felt in the loin over the affected organ; it is of a dull, heavy, dragging character. Hematuria is generally remittent; the amount of blood passed is not great; it is thoroughly mixed with the urine, and the blood-cells are altered. A larger calculus, producing suppuration, is suggested by pus in the urine with pain on pressure and perhaps increased resistance in the loin. A calculus blocking the ureter and producing hydronephrosis is suggested by feeling a soft, elastic tumor of variable size through the abdominal walls or in the lumbar region; but this is apt to disappear simultaneously with the passage of a large amount of urine. The attacks usually recur and the urine becomes alkaline or putrid. Vesical irritation, pain, retraction of the testes, and gastric disturbances are other symptoms frequently met with in all forms of renal calculus. In case of renal colic there is acute suffering, the pain shooting down the ureter to the testicle or labium majus and often radiating to the thigh. There may be nausea and ineffectual vomiting, vesical tenesmus, faintness, cold sweating, and even collapse. Oftentimes the pain ceases as suddenly as it began; but relief is not permanent unless the stone has receded into the pelvis of the kidney or has passed into the bladder. The paroxysms of pain recur at intervals of from a few minutes to several hours or days.

In a personal case there were calculi in both kidneys; the size of the calculus was $3\frac{1}{4}$ inches by 2 inches by 2 inches. There was comparatively little discomfort and pain, considering the size and irregularity of

the stone; both kidneys were found healthy at the operations. The calculus was broken into two large fragments and one small one, articulating by facets, and in a way resembling a knee-joint with patella. The joint was movable in a front to back direction, and was flexed whenever the patient bent her back. Ord (*Brit. Med. Jour.*, Aug. 20, 1910).

The stone may remain in the kidney and prostate many years without producing any pain. In 10 per cent. of the writer's cases pain had been entirely absent at all times. Renal colic was present in only half the cases. Pain, when present, had been attributed to the urethra and its appendages, movable kidney, sacroiliac disease, appendicitis, and biliary colic. Abnormal urine is a most constant sign of renal and ureteral calculi. Albumin was present in 82 per cent.; pus in 42 per cent.; blood in 80 per cent. H. Cabot (*Amer. Jour. of Urol.*, Jan., 1912).

The following points are emphasized by the writer: Early and careful urological examination of all patients suffering with pain in the back, in order that the diagnosis may be made early. In some cases there were no symptoms, and in many the only symptom was a dull ache in the loin, relieved by rest. The urine may show a few pus and blood cells, or be negative or full of pus. The X-ray is almost infallible in the diagnosis. Hutchinson (*Can. Med. Assoc. Jour.*, x, 250, 1920).

DIAGNOSIS.—In the differential diagnosis from stone and malignant or villous growths of the bladder the imperfect mixing of the blood with urine, the larger amount of blood, less altered blood-cells, the presence of clots, and more severe pain would be of aid. In the case of malignant growths of the kidney the cachexia and the palpation of a tumor, possibly irregular in outline, are of use in establishing a diagnosis.

The Röntgen rays have been used by a considerable number of surgeons, and with quite satisfactory results in most cases. Calculi of calcium oxalate give the most distinct pictures, those formed of urates are less easily recognized, and phosphatic calculi are most difficult to photograph.

The sources of error in the X-ray diagnosis of renal calculus are as follows: Obesity. Inadequate preliminary preparation of the patient. Conditions of the abdomen or pelvis which offer shadows of such unusual density as to obscure those of the kidney or of a possible calculus, such as the pregnant uterus, tumors, cysts, or ascites. [This should include fecal masses if preliminary purgation be omitted. Ed.] Surgical dressings, drainage tubes, etc. The presence of unusual or abnormal conditions or objects which cast shadows that may simulate those of stones in the kidney or upper portion of the ureter: first, those outside the kidney, such as calcified lymph-glands, foreign bodies in the intestinal tract, especially the appendix, foreign bodies in the abdominal parietes, irregular areas of calcification in the lower costal cartilages, scar tissue, and moles; and secondly, those within the kidney, such as pyelitis, abscess, or scars. Misplaced or supernumerary kidneys or ureters. Conditions or objects which may, by their shadows, lead to error or confusion in the diagnosis of calculus in the lower portion of the ureter, such as phleboliths, calcified lymph-nodes, and sesamoid bones. Certain anatomical structures, such as in the case of stones obscured by the shadows of the pelvic bones and the lower ribs. The consistency of the calculus. Pancoast (*Amer. Jour. of Dermat.*, May, 1911).

Instantaneous exposures are liable to show up the stones much better than longer ones unless the kidney is completely immobilized. Arcelin (*Lyon méd.*, June, 1911).

The following routine examination should always be employed: Examination of the urine, X-ray, ureteral catheterization, and test of the kidney function. H. Cabot (*Amer. Jour. of Urol.*, Jan., 1912).

Two cases of calculus, one in the kidney and one in the ureter, the presence and location of which were determined by pyelography. An opaque sound is introduced through the ureter into the pelvis of the kidney and an X-ray picture taken. Then collargol is injected through the sound until pain is felt in the kidney region, and another picture is then taken. The collargol outlines the form of the pelvis and calices. The exact location of the calculus is shown and, if it is entirely surrounded by collargol, it is evidently movable. The operative procedure to be followed depends on the size and location of the calculus. Nogier and Reynard (*Jour. Amer. Med. Assoc.*, from *Lyon méd.*, Dec. 22, 1913).

The only disadvantages of stereography of the urinary tract as compared with the ordinary single-plate method of examination are the increased technical difficulties and the greater expense. Accuracy in these examinations is of such great importance as to justify the increase in expense and in labor necessary for the stereoscopic method. Stereography reduces to a minimum the errors from the following sources: (a) Artefacts in the plates resembling stone which may appear in one plate, but not in two in the same place. (b) The mistaking of extraurinary bodies for calculi. (c) Overlooking the shadows of calculi which are superimposed on bone shadows, especially the heavy stones of the pelvis. (d) The knowledge of depth and perspective which these stereoscopic examinations present gives confidence in the estimation of the size, outline, and position of the kidneys. Caldwell and Imboden (*N. Y. State Jour. of Med.*, Mar., 1914).

ETIOLOGY AND PATHOLOGY.

—Renal calculus occurs most frequently in males, before the age of 15 and in the later years of life. The uric or lithic acid diathesis (lithemia), gout, an excessive meat (proteid) diet, and a sedentary life apparently predispose to nephrolithiasis. Its formation depends upon the **gluing** together of crystalline particles or amorphous salts in the urine by colloid material from blood-clot or mucus. The masses thus formed vary in size from sand to that of a hen's egg; some of them assume the shape of branches of coral. The nuclei of calculi are said to consist most commonly of ammonium urate in children, uric acid in adult life, and calcium oxalate after the fortieth year. The phosphates, cystin, and xanthin less frequently give rise to renal calculi.

A small stone may be lodged in healthy renal tissue, giving rise, perhaps, to bleeding, congestion, and inflammation and various nervous symptoms; or, it may cause the formation of an abscess in the substance of the kidney. Gravel may pass from the uriniferous tubules and be carried away by the current of urine without causing symptoms. A small stone may pass along the ureter with difficulty, causing renal colic; it may remain a movable body in the pelvis, by its irritation producing pyelitis or by stopping the ureteral orifice produce hydronephrosis; or, it may be lodged in the pelvis or calices, forming a large, sometimes branched calculus, and give rise to inflammation, suppuration, and thickening of the tissues about it.

In some parts of the world infantile lithiasis is practically unknown. In Hungary and in the central part

of Russia along the Volga it is quite common. Von Bókay (*Zeit. für Kinderheilk.*; *Med. Record*, Aug. 2, 1913).

Kidney pain may occur in cases of stricture or obstruction of the ureter at the ureteropelvic junction by aberrant vessels, renal tumor, fascial bands, etc., ureteral obstructions from tumors in the abdomen and pelvis (*e.g.*, uterine fibroids, cancer of the cervix uteri, etc.); certain bladder lesions, *e.g.*, benign and malignant growths, diverticula, etc.; seminal vesiculitis; inflammatory conditions of the broad ligaments and of the appendix; obstruction of the urethra by stricture and prostatic hypertrophy. S. H. Harris (*Med. Jour. of Australia*, Jan. 18, 1919).

PROGNOSIS.—The passage of gravel without marked symptoms tends to recur or persist, and subsequent formations are apt to be larger and cause alarming symptoms. A fatal issue may follow an attack of renal colic. Large latent calculi of long standing are generally incurable and lead to pyelonephritis, pyo- and hydro- nephrosis, perinephritic abscess, and uremia. The prognosis should always be a guarded one.

TREATMENT, MEDICAL.—During the attack of colic the patient is to be given the **hot bath** and **hot drinks** of **lemonade** or **soda-water**, while **hot fomentations** are to be applied to the **loins**. If these measures are insufficient to bring relief, **morphine** and **atropine** or even **chloroform** may be used.

Lying in bed usually prevents recurrence of hemorrhage. If the bleeding is excessive, operative measures are the only resource. A constant dull pain may get transient relief from mild narcotics, but **glycerine** is more effective, a tablespoonful every three hours up to 150 c.c. (5 ounces), with a little tincture of bitter orange peel and tincture of gen-

tian to prevent nausea. L. Casper (Med. Klinik, Oct. 6, 1912).

To aid in expulsion of calculus from the kidney by far the best treatment is: **Spirit of turpentine** in 10-minim (0.6 c.c.) doses in gelatin capsule *t. i. d.* Diet of milk, each tumbler diluted $\frac{1}{4}$ part with water, milk to be slightly warmed and drunk slowly. Fish and dry toast may be taken once daily. The patient is to **rest recumbent** during the regimen and to take occasional **hot sitz baths**. The treatment to last six days consecutively, then after a two-day interval it is repeated once or twice, if necessary. F. S. Watson (Boston Med. and Surg. Jour., Jan. 9, 1913).

The writers employed their method of **non-operative removal** of ureteral calculi in 31 cases during the past 3 years and have been compelled to operate upon only 2 of the patients. The treatment consists in first passing a No. 5 bismuth catheter into the ureter until it meets resistance. A röntgenogram then will show the location and size of the stone. Then 2 c.c. ($\frac{1}{2}$ dram) of a 2 per cent. solution of **cocaine** are injected slowly at the site of the impaction and 3 or 4 minutes later the catheter is passed beyond the stone and 10 c.c. of **sterile oil** are injected. If the catheter cannot be passed beyond the stone the oil is injected with some force to dislodge the stone. The patient is then kept well under the influence of **morphine**, drinks water to assist in expelling the stone, while **hexamethylenamine** is administered. The treatment is repeated every second or third day until the stone is expelled, a larger catheter being used each time to dilate the ureter. Crowell and Thompson (Jour. Amer. Med. Assoc., Aug. 10, 1918).

Between the attacks attention must first be directed to hygienic and dietetic measures. **Moderate exercise** is to be taken daily **in the open air** and the patient is to lead as **quiet and temperate a life** as is possible. Over-eating of **red meats** and of nu-

cleoproteins (liver, sweetbread) and indulgence in **alcohol** should be **prohibited**. Large quantities of **water**, either **mineral**—such as **lithia**, **Poland**, **Carlsbad**, and **Vichy**—or **distilled**, are to be taken daily. **Bicarbonate or citrate of potassium** given in 1-dram doses in a tumblerful of water two or three times daily, or **benzoate or carbonate of lithium** in 5-grain doses three times a day, is of value. **Piperazin** has been claimed by some to be a solvent for uric acid calculi and may be exhibited in 5-grain doses three or four times daily. Von Noorden and Strause advise the use of **calcium carbonate** in doses of from 10 to 20 grains (0.65 to 1.3 Gm.), thrice daily. They believe that the calcium combines with the acid phosphates in the intestines, and thus reduces the deuterophosphates in the urine, leaving the protophosphates to dissolve the uric acid.

The **urine** should be **kept faintly acid**, the reaction being tested at intervals for that purpose. The **alkaline** treatment must be temporarily suspended if the urine becomes **alkaline**; otherwise, a secondary deposit of phosphates around the uric acid stone is favored. Lumbar pains call for occasional doses of analgesics, such as **phenacetin**, **belladonna**, **hyoscyamus**, **codeine**, and **diuretics** (**spirit of nitrous ether**, **buchu**, and **uva ursi**). Renal hemorrhage demands the use of **ergot** or the astringents, **alum** and **gallic acid**. When the calculus is composed of phosphates or of calcium carbonate the urine should be made acid through the use of **saccharin** or **benzoic or boric acid**. When the hemorrhage persists or the stone is of such dimensions or shape that it cannot be passed, etc. (see next article: **KIDNEYS**

AND URETERS, SURGERY OF), either **lithotomy** or **litholapaxy** may have to be resorted to.

The mortality of **litholapaxy** operation is 1.6 to 6 per cent., while the mortality of suprapubic lithotomy is from 10 to 20 per cent. It is the operation of choice in all uncomplicated cases of stone. A. T. Cabot (Jour. Amer. Med. Assoc., Nov. 30, 1912).

Before attempting any operation it is necessary to be satisfied as to the functional activities of the renal tissue, to be assured that the reserve force of the healthy, or least diseased, kidney is sufficient to sustain the renal function in the event of the necessity of nephrectomy, which cannot always be foretold. Stones situated in the lower terminal (2.5 cm. of the ureter) were removed transvesically. In renal calculus the kidney was exposed and, if possible, delivered through an oblique loin incision; the stone was palpated and an incision made over it and the stone removed with forceps. In 9 instances palpation failed to demonstrate the presence of stone. In 5 of these it was correctly located with the needle. Needling is a practical, harmless, and valuable procedure in cases in which palpation failed. The total mortality in the operated cases of this series was 6.5 per cent. J. B. Deaver (N. Y. Med. Jour., Mar. 1, 1913).

There is always some evidence in the kidney of obstruction to the outflow of urine. In a large measure the stasis of urine in the pelvis is due to the upright position. The profession should be taught early diagnosis of renal calculi, and prophylactic treatment after operation should be insisted upon. The operation performed and advised by the writer is a **nephropexy**, in which the kidney is sewed in a transverse position, strips of fascia lata being used to braid into the capsule of the kidney, and the fascia lata fastened into the deep muscle. O. S. Fowler (N. Y. Med. Assoc., July 5, 1913).

In acute renal colic, the use of **morphine** and **atropine** hypodermically followed by 2-ounce doses of glycerine with large quantities of distilled water are of value in aiding the passage of stones spontaneously, especially, if the patient is in a very hot bath. The diagnosis may be confirmed, *a*, by careful urine examination; *b*, by X-ray examination with intensified shadows if necessary; *c*, by the introduction of ureteral shadow sounds; *d*, by pyelography in doubtful cases, provided the clinician will consider all factors together. A. J. Ochsner (Trans. Amer. Med. Assoc.; N. Y. Med. Jour., June 14, 1919).

HYDRONEPHROSIS.

DEFINITION.—A collection of urine in the pelvis and calices of the kidney due to obstruction.

VARIETIES.—In addition to the usual or more or less typical form, two subvarieties are distinguishable: (*a*) the intermittent, and (*b*) hydronephrosis paraplegica. In the latter type paraplegia develops as a complication, and beyond the mention of this fact it scarcely deserves a separate clinical description.

SYMPTOMS.—The clinical symptoms are somewhat dependent upon the cause and stage of development of the hydronephrosis. When, as generally happens, the condition is unilateral, it often escapes notice, since the symptoms are slight or even wanting, until a tumor is discoverable. The ureter on the opposite side may become obstructed, followed by uremic manifestations, the latter occurrence first inviting attention to the condition. In the bilateral form the uremic symptoms are apt to supervene early.

The flow of the urinary fluid may be noticeably diminished, though subject to variations. The patient may

complain of frequent and acute pains that shoot about the affected loin-space and downward toward the thigh. Abnormal sensations of weight and a dragging discomfort, at times amounting to a dull, aching pain, are quite common. The latter symptom, particularly in large hydronephrotic tumors, may be continuous and distressing; less frequently the cyst is painless.

Case in which at the operation the entire intestinal tract was found displaced to the left. The uterus and adnexa were normal. Ten quarts of translucent amber fluid were withdrawn by means of a trocar. An incision was made in the posterior perineum and through the wall of the sac. The hand introduced into this cavity confirmed the diagnosis that the cyst was a hydronephrosis of the right kidney. The ureter and renal vessels were located and ligated, and the entire sac removed. It was estimated that 2 quarts more of fluid escaped during this process, making the estimated contents 12 quarts. The resultant cavity was drained through the lumbar region. The patient made an uneventful recovery. J. Van Doren Young (*Med. Record*, April 5, 1913).

The tumor may cause obstinate constipation from pressure on the colon, or it may, if moderate in size, provoke diarrhea, from the pressure irritation. Resulting from the same cause are flatulency and irregular bowel action. Among gastric symptoms, anorexia is the most common, while nausea and vomiting are sometimes associated. Hematuria may be present, but is rare and usually occurs with attacks of pain.

A hydronephrosis may be an underlying cause of attacks of acute abdominal pain. In cases due to constant mechanical obstruction to the ureter, a complete uranalysis as a

rule reveals no pathological findings and an X-ray examination of the kidney and ureter will also generally prove negative. S. P. Martin (*N. Y. Med. Jour.*, May 4, 1918).

Slight albuminuria may be present. The urine is of low specific gravity, the urea is diminished, and the phosphates are greatly reduced in most instances. Renal casts are absent, as a rule, unless chronic nephritis coexists as a complication.

In all except the earliest stages there is easily detectable a swelling in the region of the affected kidney. It increases in size in a slow and gradual manner, and there is great dilatation of the pelvis of the kidney. Visible bulging usually occurs in the hypochondriac and lumbar regions.

The writer found 20 cases on record in which a hydronephrosis ruptured and the resulting retroperitoneal cyst was taken for true hydronephrosis, the result being a blunder in operating, the surgeon opening the abdomen from the front and having to go through the peritoneum or make another incision in the rear. The rapid growth of the tumor is not characteristic of true hydronephrosis. Babitzki (*Archiv f. klin. Chir.*, xcvii, No. 4, 1912).

On palpation, a rounded, firm, more or less elastic and sometimes fluctuating tumor is detected. The enlargement may be slightly tender. I would advise energetically that, when the tumor is of moderate size it is most readily felt when the abdominal position is employed, examining bimanually. Percussion elicits dullness over the mass, except in cases in which the colon overlies it, when the note is tympanitic: a characteristic sign of renal tumors. Moderate enlargements generally do not descend during inspiration.

Intermittent Form (Landau).—In this variety decided variations in the size of the tumors occur, *i.e.*, coincident with a more or less sudden increase in the quantity of urine passed (polyuria) the tumor quickly diminishes. On the other hand, the enlargement gradually increases from retention as the flow of urine decreases. The principal cause of hydronephrosis is a movable kidney, and hence the affection occurs mostly in women that have borne children. According to Albarran, the polyuria which commonly follows the attacks of pain in movable kidney is due to excessive urinary secretion, and not to a flow of urine which has previously been retained in the pelvis of the kidney. He reports a number of cases in which an operation for movable kidney, in patients suffering from intermittent hydronephrosis, was performed by himself, and total absence of dilatation of the pelvis of the kidney was noted.

In intermittent hydronephrosis idiopathic dilatation of the kidney pelvis is the primary disturbance. Ultimately this entails kinks and distention.

In a personal case, one of intermittent hydronephrosis on the right side, X-ray examination revealed extreme dilatation of the kidney pelvis on both sides, but no symptoms from the left kidney. Attempts to dilate the ureter and rinse out the pelvis might be useful, but the only logical treatment is to transplant the ureter to the lowest part of the sagging renal pelvis. L. Bard (*Jour. d'Urol.*, ix, No. 4, 1920).

Preceding and accompanying the polyuria in these cases are colicky pains, and hematuria is not uncommon. For obvious reasons, the tumor in intermittent hydronephrosis dis-

plays considerable mobility. The general features consist merely of a certain loss of flesh and strength incident to the associated worry and anxiety. The filling of the nephrydrotic cyst, the enlargement, and the pain of subsequent discharge, with marked diminution of the tumor, recur with variable frequency. Among the causes that are apt to produce a kinking of the ureter, and thus excite an attack, are violent physical exertion; jarring or jolting, as in riding or driving, or acute gastrointestinal derangement, and strong emotions.

The duration of the attacks varies from several hours to a day, though the cyst may continue to increase in size for several days after the pain has disappeared. During the intervals, and even while the greatly increased flow of urine is present, the patient feels tolerably comfortable.

The occurrence of chills, fevers, and sweats, rapid pulse, nausea and vomiting, and abdominal distention is indicative of suppuration, and the appearance of the common sequel—pyonephrosis. This is confirmed by the cloudy urine, revealing pus, following both discharge and aspiration. Chronic nephritis may supervene, as shown by the lower specific gravity and the presence of albumin and casts in the urine. The arterial tension will then be increased, as a rule. Among other sequelae may be mentioned acute febrile or chronic afebrile uremia, the latter having been mentioned above.

The cystoscope and ureteral catheter are important aids in the recognition of hydronephrosis to determine the character of any obstruction, torsion, calculus, growth, etc., that may be present. The X-rays are useful mainly for the detection of calculi.

The ureteral catheter can alone at times confirm the diagnosis, as in 2 of the 4 cases reported by the writer; in others it may be necessary to open up the region. His experience shows the possibility of complete functional restitution if the obstruction to the passage of urine is removed early, before the formation of an encysting membrane and before the kidney tissue has been irretrievably injured by the distention. Ekelhorn (*Nordiskt Med. Archiv*, xli Surg., No. 2, 1909).

Form of hydronephrosis due to distortion of the ureter. It is important to seek some interior or exterior structural defect of the ureter as a cause for the renal retention, whether associated or not with undue mobility of the kidney. Chetwood (*Amer. Med.*, Feb., 1912).

An X-ray examination in and of itself, is of negative value only, excluding renal calculus and aiding in the exclusion of renal tuberculosis, but it cannot reveal the position or outline of the renal pelvis. The writer advises the injection of the renal pelvis with silver salts (which cast a shadow) through the ureteral catheter, when the exact size, position, and relation of the renal pelvis may be studied by the X-ray. This the writer calls pyelography. Hugh Cabot (*Jour. Amer. Med. Assoc.*, Jan. 4, 1913).

The normal kidney shows dim X-ray shadows of the 2 main calyces, and of the small, slit-shaped pelvis. Sharp beginning pelvic shadows are significant of beginning hydronephrosis. Of still greater importance is the ureteropelvic junction, which in beginning hydronephrosis becomes angular in contour, while the pelvis becomes sacculated. Dilatation of the renal pelvis and of the calyces may be found independently or simultaneously. In sacculatation of the whole kidney the shadows of the calyces exceed in size that of the pelvis. M. Krotoszyner (*Calif. State Jour. of Med.*, xv, 58, 1917).

In a boy of 9 an operation revealed that the ureter was kinked by a

supernumerary artery. C. Martin-DuPan (*Revue Med. de la Suisse Romande*, Oct., 1917).

DIFFERENTIAL DIAGNOSIS.—

Pyonephrosis may be eliminated in the absence of an abundance of pus-cells in the aspirated fluid and of the general symptoms of suppuration.

Echinococcic Cyst.—In this disorder there is a history of close association with dogs; the size of the tumor is constant and slowly increasing; urea is not demonstrable in the aspirated fluid. In fluid removed by puncture the echinococcus hooklets, shreds of membrane, and sodium chloride are found. A movable kidney is not detectable. The urine is constant in amount. Recurrences do not occur.

Additionally, hydronephrosis must be distinguished by exclusion from ovarian cyst, cystic kidney, and tumors of the spleen, liver, and gall-bladder. Very large cysts may be mistaken for ascites. The assured presence of the colon over the tumor is diagnostic, and a chemical examination of the fluid obtained by the use of the exploring needle will clear up most cases. With reference to ovarian cyst, however, it is to be recollected that a slight amount of urea is sometimes found in it.

Case in which the kidney contained 30 quarts of fluid at necropsy. The patient was a woman of 25 and the first signs of trouble had been noted at the age of 8. For years it was ascribed to tuberculous peritonitis and the hydronephrosis assumed to be ascites until finally chemical examination of the puncture fluid excluded ascites, as there was only 2.2 Gm. of albumin; experience has shown that with ascitic fluid the proportion of albumin is never below 3 Gm. per liter. Mosny, Javal,

and Dumont (*Jour. d'urol.*, Jan., 1913).

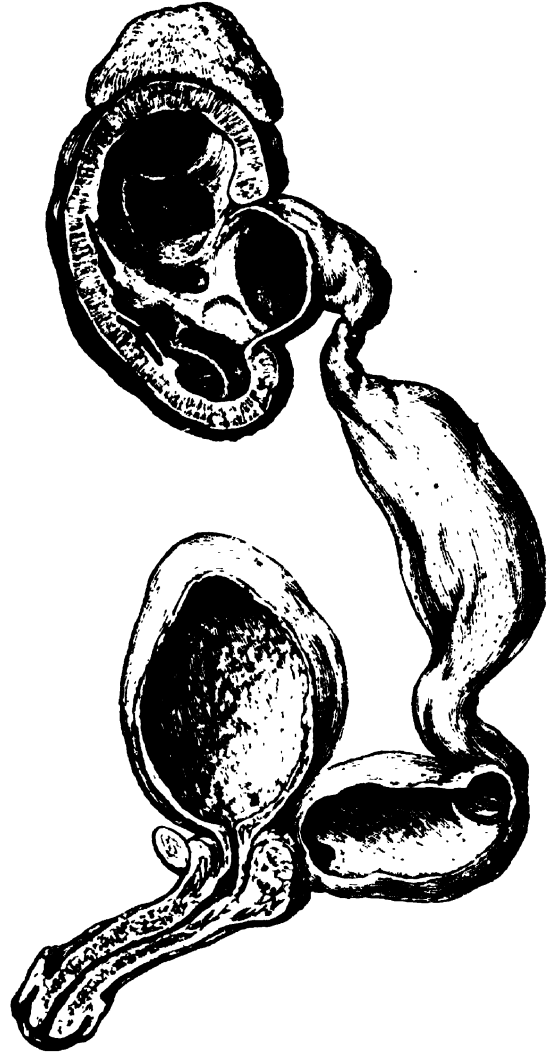
ETIOLOGY.—The principal factor in the production of dilatation of the pelvis of the kidney is chronic or prolonged obstruction, caused by occlusion of the ureter, either congenital or acquired. Probably from 20 to 35 per cent. of the cases are congenital (Roberts). The former cases are due to obstruction induced by a defective development or malformation of the ureter of one or both sides, usually the latter.

There may be atresia, a valve-like formation, or an acute (oblique) insertion of the ureter into the kidney.

Excessive dilatation has occasioned more or less mechanical difficulty during labor. The causes, both predisposing and exciting, of the acquired cases are varied, and may be conveniently grouped in tabular form as follows: 1. Sex, women being more often subject to hydronephrosis than men, especially those having borne children. 2. Age; apart from the congenital cases, hydronephrosis is most common in middle and advanced life. 3. Impacted calculi in the ureter or renal pelvis. 4. Disease of the ureteral walls, as inflammatory thickening and cicatricial stenosis from ulcers. 5. Flexion and twisting of the ureter, as from movable kidney. 6. Pressure upon the ureter from without, as by tumors and constricting bands (pelvic adhesions). The gravid and retrodisplaced uterus, uterine and ovarian neoplasms, and similar conditions causing compression or traction and obliteration of the lumen of the ureter are found in this class. 7. Diseases and tumors of the bladder that involve the ureteral orifices, particularly carcinoma, or that cause reten-

tion, as prostatic enlargement. 8. Urethral stricture.

The writer found experimentally that sudden, complete obstruction of 1 ureter produces hydronephrosis in



Urinary organs of a newborn child, showing mechanical obstruction. (Bland Sutton.)

most cases, though rarely an atrophy of the kidney develops. When hydronephrosis occurs, the venous collaterals are well developed; atrophy is due to lack of development of these. When obstruction to the ureter is partial or intermittent the hydronephrosis is of greater size than when it is complete and permanent, for in the latter case urinary secretion

ceases before the venous collateral circulation has time to develop. Barney (*Annals of Surg.*, May, 1917).

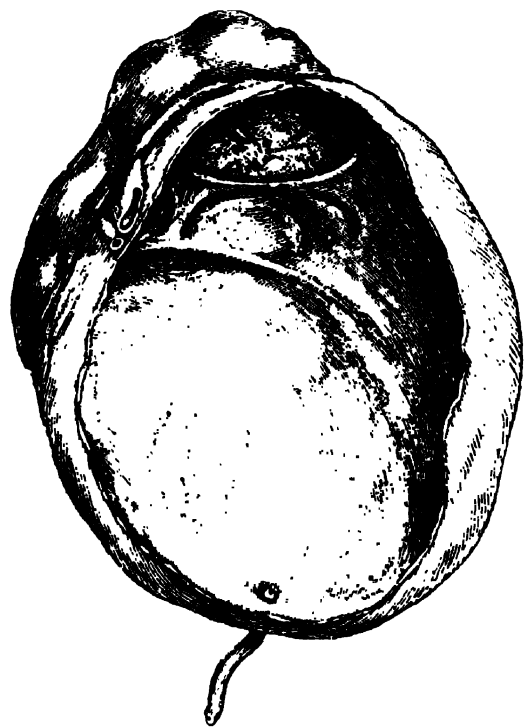
PATHOLOGY.—The cyst caused by a dilatation of the pelvis of the kidney, often assuming the shape of the latter, may become very large, containing as much as several gallons of fluid. The external appearance of the walls may be lobulated, particu-

tumor or dilatation. Accumulated liquid causes flattening and atrophy of the papillæ and gradually of the tubules and glomeruli, and in extreme cases remnants only of the renal structure remain in the walls of the hydronephrotic cyst. In the renal parenchyma (medullary and cortical) there is a growth of connective tissue, a chronic nephritis with degeneration and atrophy of the renal cells. The mucous membranes lining the pelvis and calices first become thinned, and later thickened, by the growth of connective tissue, thus forming a dense sac-wall.

The fluid contained in the sac is usually a clear, thin, yellowish, watery urine. Its composition, however, varies. The specific gravity is low, and the reaction is often slightly alkaline. Traces of albumin, urea, and uric acid are found, although in long-standing cases the latter two ingredients may be absent. Turbidity may be observed, owing to admixture with pus, blood, or epithelium, but only in instances in which previous inflammatory conditions—as a calculous pyelitis—or local complications—as hemorrhage, suppurative inflammation, and the like—have existed.

Considerable confusion still exists as to the relations of false and true hydronephrosis. In true hydronephrosis the sac which contains the fluid is the distended pelvis of the kidney, while in false hydronephrosis the fluid is contained in a sac outside the kidney. A. T. Cabot (*Boston Med. and Surg. Jour.*, Feb. 28, 1907).

PROGNOSIS.—In unilateral hydronephrosis, the more common variety, the prognosis is guardedly favorable, on account of the establishment of compensatory function on the part of the unaffected kidney, and this is



Large intermittent hydronephrosis due to an inadequate ureter. (Bland Sutton.)

larly in medium-sized sacs; the interior, however, shows only partial septa projecting from the walls into the cavity of the sac, as a rule. According to the site of the obstruction one or both ureters may also be dilated, and if, as is usual, one kidney is involved, its fellow is often hypertrophied. Marked enlargements cause displacement of the adjacent abdominal organs.

Atrophy of the renal tissues results and is proportionate to the size of the

particularly true if the case be one of movable kidney. The bilateral affection is always grave, having about the same outlook as chronic pyonephrosis. Among dangerous accidents and complications may be mentioned uremia, rupture of the sac, and infection of the cyst by pus organisms. Recovery may ensue in rare instances in which a spontaneous discharge of the fluid occurs.

TREATMENT.—The congenital form, when bilateral, is not amenable to treatment. It is rarely feasible to force the fluid out by manipulation of the tumor. This method tends to remove the occlusion, when caused by a slight twist or kink in the ureter. In unilateral hydronephrosis carefully **tapping** the cyst may be practised, thus overcoming the mechanical discomfort. **Operative interference**, with a view to removing the special obstructive cause, is also to be advised in suitable cases.

In acquired hydronephrosis symptomatic treatment only is required in moderate enlargements, though sometimes gentle **massage over the sac**, properly directed and cautiously applied (to avoid rupture), may cause a reduction in the size of the cyst. In the majority of instances surgical measures only are of use. **Repeated aspiration** of the sac, as in a few reported cases, accomplished a cure. Surgical measures also embrace **nephrotomy** and **drainage**, **nephrorrhaphy** (particularly when caused by movable kidney), and **nephrectomy**.

Children, even during the first few years of life, may undergo **nephrectomy** well; very good results are obtained when the operation is a primary one in both traumatic and congenital cases. Engler (Amer. Jour. of Urol., Oct., 1908).

In no case in which the symptoms are mild, as in some instances of the intermittent variety, should surgical procedures be undertaken.

JAMES M. ANDERS,
Philadelphia.

KIDNEYS AND URETERS, SURGICAL DISEASES OF.—GENERAL DIAGNOSIS.—**Tests of Functional Activity.**—Several tests of kidney capacity have been introduced in recent years. Most of these depend upon the ability of the kidney to excrete foreign substances. *Iodide of potassium*, *salicylic acid*, and other products were used at first. More recently various coloring materials, such as *methylene blue* and *indigo-carmin*, have been administered. The time required for the color to appear in the urine and the total amount excreted ordinarily indicate the activity of kidney function. *Phloridzin* has been injected and gives rise to an artificial glycosuria, and the estimate of the glucose thus produced has been made. *Phenolsulphonephthalein*, suggested by Rowntree and Geraghty, has the advantage of being non-irritating, non-toxic, and easily used, and it determines the activity of elimination with mathematical accuracy. From 60 to 85 per cent. of the amount used is excreted by the normal kidney in two hours, and the percentage is very simply determined by the use of the Du Boscq colorimeter.

Cryoscopy (see Vol. III) is used for determining the freezing point of a solution, and gives an absolute method of determining the total dialyzable molecules in any solution. It has the advantage of giving the capacity of the kidney to excrete all substances which should pass through them; most other methods determine only one

particular substance, such as urea, the chlorides, or nitrogen, and total solid determinations are likely to be inaccurate and include albumin, if present, while cryoscopy does not. The most satisfactory method is to test the freezing point of the urines obtained from urethral catheterization, and many advocates also test the freezing point of the blood.

Although there is some difference of opinion as regards the value of the various tests of functional activity, practically all active workers in this field are agreed that at least one of the special methods of determining the functional capacity of the kidney should be applied. The usual examinations, the twenty-four-hour amount, specific gravity, amount of urea, etc., should not in any way be neglected, and together with clinical symptoms and the evidence furnished by examination are undoubtedly still the most important criteria.

Radioscopy of the kidneys is a simple and rapid method of examination which is well suited for clinical use. The patient should be examined in the standing position, a cylindrical diaphragm used to render the picture as sharp as possible, and the soft tissues compressed by means of an apparatus which the author describes (T. Nogier).

Radiography.—Inflating the kidneys with air or gas does away with the possible dangers arising from the injection of the pelvis or calices with argyrol or collargol. Injections of the pelvis increase the field of radiographic diagnosis, enabling the size and shape of the pelvis and calices to be determined in cases of hydro-nephrosis, deformity, or tumor of the kidney.

The air should be filtered through a wad of sterile cotton and may then be passed through a warmed alkaline solution. The catheter to be used should have an end that may be expanded so as to fill the lumen of the ureter (L. G. Cole).

Difficulties may attend the interpretation of shadows in the kidney and ureteral region on X-ray examination. The writer emphasizes the importance of confirmatory examinations such as stereoscopyelography and particularly wax-tipped catheterization. X-ray findings, negative or positive, alone should not be relied upon for calculi. Hyman (Med. and Surg., i, 343, 1917).

Pyelography.—It is impossible by symptoms alone to make a diagnosis of early dilatation of the kidney. Kelly's method of ureteral catheterization is not very accurate. Radiography is more definite, but kidneys vary in size and it is not possible to aver that a given kidney is enlarged. Proportional renal measurements of a series of plates carefully taken by radiography give fairly good results. The best of all methods and that which gives the most striking and accurate information is pyelography. Voelcker and Lichtenberg introduced this method in 1906. They injected a solution (2 per cent.) of collargol, which is opaque to the X-rays, into the renal pelvis and obtained a shadow which showed the contour of the renal pelvis (J. W. Thomson Walker).

Filling the kidney pelvis with oxygen is of great advantage in Röntgen-ray examination of the region, as shown by skiagrams in 3 cases. The simplicity and ease of this method and the absence of by-effects commend it as a notable progress in röntgenography. Any excess of the oxygen flows back outside the catheter in the

ureter down into the bladder, distending the wall along the way. Lichtenberg and Dietlen (Münch. med. Woch., June 20, 1911).

The present measures for pyelography are too dangerous for use with pathologic conditions in the kidney. Even with merely displaced and deformed kidneys or abdominal tumors, ordinary Röntgen examination gives equally conclusive findings without the danger from the pyelography. Hence the latter method has no justification for its use until some substance is found equally effectual for pyelography without danger of irritating the kidneys. Rydgaard (Hospitallstidende, July 24, 1918).

ANOMALIES OF FORM AND POSITION.

Absence.—*Absence of both kidneys* is a congenital defect, and is of course incompatible with life, but *congenital absence of one kidney* is not. In the latter case the organ missing is usually the left; the remaining organ supplements its work, and may indeed be supplied with two pelves and two ureters. The absence of a kidney may be suspected when dullness over the normal site of the kidney is replaced by a tympanitic note under percussion. Serious results from the anomaly are only to be anticipated when the remaining kidney becomes diseased.

Lobulated Kidney.—This is the most frequent form of anomaly, and is really a *perpetuation of the fetal lobulation of the organ*. The fissures are sufficiently deep in some instances to divide the organ into several reniculi. It is far more frequently observed in animals than in man.

Horseshoe Kidney.—From the surgical viewpoint this is the most striking of anomalies. It usually consists

in a union of the lower ends of the two organs by means of renal or fibrous tissue. At times the middle segments of the organs are found united, and, rarely, their upper ends. In all such cases, and irrespective of the location of the uniting tissues, the organ is more or less displaced. A horseshoe kidney is, as a rule, located immediately above the promontory of the sacrum, but it may descend deeper into the pelvis on either side of the spinal column. In most cases, however, especially in very thin persons, it is recognized above the sacrum.

Horseshoe kidney found once in 715 autopsies, and once in 143 operations. The mortality is 16.25 per cent., owing to an increased disposition of the patient to contract different kidney diseases. A diseased horseshoe kidney gives pain and digestive and nervous symptoms, but the diagnosis is principally made by palpation and radiography. The tumor has a median abdominal position. Botez (Jour. d'urol., May, 1912).

The writers emphasize the value of palpation in the diagnosis of this condition. In a few cases palpation from the vagina has led to the detection of the lower border of a horseshoe kidney situated unusually low down. Carlier and Gérard (Revue de chir., Aug., 1912).

Among 36 cases of gross renal and ureteral anomalies observed in the Mayo clinic during five years, 7 were found incidental to other abdominal operations, 12 were of the horseshoe type, and 6 of the single or asymmetrical type. Of 649 operations on the kidneys and ureters during this period of five years, there was an average of one serious anomaly associated with disease in every 26 cases. In the horseshoe form 90 per cent. were fused at the lower pole. At the point of union there might be only connective tissue (in 15 per cent. of the cases). Usually the fusion consisted of renal tissue and varied from

a small area to the full width and thickness of the kidney. Ninety per cent. of cases were fused in front of the great vessels. C. H. Mayo (N. Y. Med. Jour., Mar. 1, 1913).

According to Rovsing, the presence of horseshoe kidney should be suspected whenever a patient complains of an oppressive pain across the abdomen from one kidney region to the other which subsides completely when the patient assumes the recumbent position. The pain is accentuated by physical exercise and when the spine is bent backward, when the patient stands. A tumor can often be detected on the left or right side of the spine immediately above the sacral border. Hydronephrosis is a frequent complication of horseshoe kidney.

The most common disease affecting horseshoe kidney, found in 649 cases, is hydronephrosis, which later may become pyonephrosis. This hydronephrosis is apt to occur in moderately young individuals, while pyonephrosis and lithiasis are usually seen in middle-aged subjects or later. Tuberculosis is rarely witnessed. C. H. Mayo (N. Y. Med. Jour., Mar. 1, 1913).

Treatment.—The treatment of horseshoe kidney consists in separating the organs, *i.e.*, division of the isthmus. When the organs are diseased, measures appropriate to the condition present must be instituted. Either one of the operations described later in this article may be indicated, where the malformed or united organs give rise to morbid symptoms.

Besides 3 personal cases of horseshoe kidney with hydronephrosis in 2 of them, the writers found 9 operative cases on record of hydronephrosis with horseshoe kidney with operative treatment and 15 cases in which the trouble was first noted at necropsy.

Heminephrectomy in 9 operative

cases was successful in all but 1; in this the fact that the kidney was of the horseshoe type was not recognized until the attempt had been made to remove the whole kidney mass. Fatal hemorrhage followed from laceration of a large vessel. Papin and Christian (*Annales des mal. des org. génito-urin.*, Oct. 15, 1910).

When the writers do not have absolute data as to the condition of both kidneys, they always explore the other kidney, usually through a separate incision, before the removal of a tumor of the kidney or the removal of a diseased kidney. In abdominal surgery, where the type of the presenting tumor is questionable, the kidney should be palpated before removal of the tumor. In some instances transperitoneal incision is indicated. C. H. and W. J. Mayo (N. Y. Med. Jour., Mar. 1, 1913).

MOVABLE AND FLOATING KIDNEY.

The term *movable* kidney is used to designate those cases of displaced and not fixed kidney in which the movements are entirely subperitoneal. In *floating* kidney the movements are intra-abdominal; the organ is surrounded by peritoneum and has more or less of a mesonephron. The former variety is usually acquired, while the latter is said to be only congenital. This, however, is quite doubtful.

SYMPTOMS.—The subjective signs of movable kidney range from slight discomfort to intense pain. Dietl's crisis, depending, to some extent, on the amount of mobility. Most commonly the pain is dull, aching, or dragging, located in the loin and aggravated by exertion, constipation, and often by menstruation. Occasionally it is paroxysmal, not unlike renal colic. Kinking or torsion of the ureter may cause transitory at-

tacks of hydronephrosis. Gastric symptoms and disorders of digestion have also been frequently observed.

[Edebohl reported 58 cases in which he believed appendicitis was caused by the venous stasis in the region of the cecum resulting from the pressure of floating kidney. This view seems confirmed by the relief of symptoms in 12 cases by nephropexy. W. W. KEEN AND M. B. TINKER.]

On palpation, a tumor of the size, form, and consistency of the kidney can be usually made out; the tumor slips away under the fingers, generally to the region of the loin. The range of mobility may be slight, but in some cases it is so great that the tumor may be felt near or past the median line or in the inguinal region. Manipulation often gives rise to sickening pain, similar to that produced by compression of the testicle or ovary.

In 30 per cent. or more of women who come to us for a general physical examination, the right kidney is so movable that the entire organ can be palpated. This condition is so common and so seldom gives rise to symptoms that it cannot be regarded as pathological. In spite of the fact, however, many of these cases are improperly subjected to an operation to fix the kidney and cure the patient of a great train of vague symptoms which have been attributed to these slightly movable kidneys. Experience has shown, however, that these symptoms persist after these operations, proving that they have nothing to do with the condition. A. B. Bevan (*Ind. Med. Jour.*, Jan., 1909).

Movable kidney is, in part at least, a congenital defect. It is due to mechanical causes. As to its appearance suddenly under trauma or strain, the writer suspects that, in many cases in which there is a history of sudden development of symptoms that have led to the discovery of a movable kidney, the organ has been mov-

able beforehand without symptoms. In most cases the kidney does not undergo any marked alteration as the effect of mobility. The symptoms occur in three groups: The first group consists of indefinite symptoms, giddiness, faintness, anemia, palpitation, neurasthenia, etc., and particularly neuralgia; the second group of symptoms consists of those due to involvement of the intestinal tract, either reflexly or by pressure; the third consists of those due to twisting or obstruction of the pedicle. Cheyne (*Lancet*, Apr. 24, 1909).

In personal cases great intestinal distention was present in most of the attacks. Clarke (*Pract.*, May, 1911).

In 25 cases in which the writer has done nephrectomy on the right side, there were signs of appendicitis only in 3. The pain induced by the movable kidney may be mistakenly ascribed to the appendix when the latter is quite sound. When it is possible to draw the appendix out through the lumbar incision for the operation on the kidney, the probabilities are that the appendix is sound. Rolando (*Policlinico*, Surg. Sect., Feb., 1919).

The diagnosis from very mobile, distended gall-bladder and tumors of the intestine, especially the large intestine, is sometimes difficult. The kidney is much more deeply located posteriorly, however, and if it is possible to fix the liver it will be impossible to make the gall-bladder disappear as the kidney does.

A diagnostic sign by which one may instantly suspect that a loose kidney is really a factor in cases of parenchymatous nephritis, of gastric hyperacidity, or of congestive appendicitis is the condition of "splint-belly,"—rigidity of the muscles of the abdominal wall, which shows that nature is trying to put a splint on the kidney to keep it from moving about and making trouble. The symptom seems to vary in degree in proportion to the disturbance caused by the loose

kidney. Morris (*Archives of Diag.*, Apr., 1912).

The writer's conclusions, based on observations in 329 cases, are that a movable kidney may frequently escape detection, owing to a concomitant affection which masks whatever symptoms may arise from the kidney. In the absence of any disturbance, it requires no special attention. Some cases require operation. Neishtab (*Roussky Vrach*, Feb. 16, 1913).

Percussion over the back shows clearly that the normal bed of the kidney is empty. Even in the cadaver the writer was often able to determine the outlines of the kidney with great precision. Galdi (*Riforma medica*, Oct. 23, 1920).

In the case of intestinal tumors stenosis of the gut sometimes settles the diagnosis. This can readily be established by X-ray examination after a bismuth meal. Tumors of the omentum occupying the right hypochondrium are rare, growths of the pylorus usually cause greater gastric disturbance and are situated higher and nearer the median line, and impacted feces disappear after a purge.

ETIOLOGY.—The condition is much more common in women; it is most frequent during the child-bearing period and particularly in women who have borne several children. This is thought to be because of the lax condition of the peritoneum and of the abdominal wall, and the absorption of the circumrenal fat thus induced, for movable kidney may follow emaciation due to any wasting disease. The right kidney is affected four times as often as the left; this is attributed to the proximity of the liver, which, in its movement downward with the diaphragm, may force the kidney before it. Traumatism has been mentioned as a cause, but this is not in accord with the infre-

quency of the condition among males. Probably in most cases renal mobility is to be attributed to a combination of several causes, and accompanies general enteroptosis of greater or less degree.

Only 2 cases of dystocia due to prolapse of a floating kidney into the pelvis in front of the pregnant uterus were found in the literature by the writer. Both mothers recovered and both infants were lost. One baby was delivered by version and extraction, but the kidney so filled up the pelvis that the delivery of the after-coming head was unduly delayed and fatal asphyxia resulted. The other child was delivered with Tarnier's basiotribe. The case reported by the author makes the third on record. The patient was a primipara aged 21. She gave a history of attacks of acute pain in the right side, followed frequently by the passage of a large quantity of pale urine. The antepartum examination disclosed no abnormalities, except a slight contraction of the transverse diameters of the pelvis. An examination made after three hours of hard second-stage pains disclosed the cervix nearly dilated, and the head well engaged at the brim. The concavity of the sacrum was occupied by a mass of the shape, size, and consistency of the right kidney. The kidney was freely movable, and during examination by the physician it was forced up over the brim of the pelvis. The woman was then delivered by forceps. Immediately following delivery, and a few days later, at the time of repairing a vaginal laceration, the kidney could be made out freely movable in the right abdomen and capable of being replaced. The baby weighed $8\frac{3}{4}$ pounds, and was born alive and well. Willson (*Wash. Med. Annals*, Jan., 1911).

TREATMENT.—In a very few cases the application of a suitable abdominal support is all that is necessary.

The great majority of the symptomatic movable kidneys can be cured symptomatically by wearing a **corset**; in fact, the writer's present opinion would be that not more than 1 per cent. require operation. While, however, a corset laced tightly at the waist line would readily support a replaceable kidney, the more grave and detrimental chronic gastrointestinal ptosis and its symptoms are not relieved, but made decidedly worse by the indispensable tightening of the corset at the waist line. The essentials of a corset made to relieve all these symptoms must be suited to the individual case as carefully as any other orthopedic apparatus, but it must conform to the fashions or women will not wear it. The distinguishing features are as follows: "1. Gravity replacement in the semi-opisthotonos posture, massage, exercises, and rest cure. 2. Support of the replaced organs by a special, made-to-order corset of fashionable design, 'V'ed in front, fastened by one lace, inserted from the waist down, put on and laced while in the semi-opisthotonos posture, and worn at all times, except when lying down." A. E. Gallant (Jour. Amer. Med. Assoc., Nov. 7, 1908).

The permanent restoration of a loose kidney to its normal position by prolonged recumbency and forced feeding is unsound in principle and impossible of performance. In many cases immediate good results succeeded, but quick relapse followed a return to ordinary life. The reasons are that the kidney is not retained in position by the perirenal fat, and that absorption of the fat of the capsula adiposa appears in most cases to be a result and not a cause of the abnormal motility. Billington (Lancet-Clinic, May 25, 1912).

The writer condemns the surgical treatment of movable kidney, and asserts that it should be treated like enteroptosis. He applies a **belt** that will effectually support the abdominal region, keeps the action of the bowels free, preferably by means of **salines**,

because of their action as chologogues, gives a **diet** principally of **meat**, and prescribes **sodium bicarbonate**, half a tumbler of **Grand Grille Vichy water** every morning, heated to 104° F. G. Monod (Pract., Nov., 1913).

If non-surgical measures prove unavailing, operation should be considered if the severity of the symptoms warrants it.

A fully developed movable kidney that does not give rise to symptoms will not require treatment, and such patients should be assured of the harmlessness of their condition. If the abdominal walls are flaccid some means of support, as **bandages** or a **corset**, should be employed and will be found sufficient in the majority of uncomplicated cases. They must, however, exert pressure upon the entire abdomen from below upward and from above backward, and lift the kidney indirectly, that is, through the subjacent abdominal contents. **Rest on the back** relieves the frequently recurrent pains, but he has never seen any permanent restoration of the kidney to its normal condition through prolonged use of this method. **Massage**, if employed at all, should be very gentle. **Operative fixation** of the kidney in cases where this condition causes marked disturbance and interference with work gives excellent temporary results in a large number of instances, although the end-results are less promising, and the procedure is not free from risk to life. Fürbringer (Deut. med. Woch., Nu. 18, 1911).

Operative Procedures.—*Nephropexy or Nephrorrhaphy.*—By this term is meant the operation for fixation of a movable kidney. The operation was first performed in 1881 by Hahn, of Berlin, who operated upon 2 cases of movable kidney in April of that year.

Before the introduction of nephropexy, nephrectomy was performed for the relief of movable kidney; but at

present the latter operation would only be considered justifiable in case of some severe complication, such as strangulation or suppuration.

Extracapsular fixation of the kidney, or nephropexy, is surgically feasible, is effective primarily, and comes nearer than any other procedure to restoring the pathologically movable kidney to its normal anatomical relations and to the exercise of its normal physiological functions. C. A. L. Reed (Jour. Amer. Med. Assoc., Sept. 17, 1910).

Technique of Nephropexy.—The patient is placed on the sound side, considerably inclined forward, resting on a hard pillow or pad, so as to increase the costoiliac space. The incision for nephropexy answers also for nephrotomy, nephrolithotomy, and nephrectomy. The twelfth rib is carefully located by both palpation and counting, to avoid the possibility of opening the pleura. Beginning $\frac{1}{2}$ inch below the last rib and close to the outer border of the erector spinæ, the incision is carried obliquely downward and forward for about 7 to 8 cm. (3 inches). It divides the skin and subcutaneous tissues, the superficial fascia, the latissimus dorsi, the external oblique, the internal oblique, the transversalis with its aponeurosis, and the deep layer of the lumbar fascia. The anterior border of the quadratus lumborum may require division if impossible to retract it sufficiently. The muscle-splitting method of exposure may be substituted for direct incision in many cases requiring moderate exposure, the advantages being lessened risk of injuring blood-vessels and nerves and of postoperative hernia. With retraction the perinephric fat usually bulges in the wound and is separated prefer-

ably by blunt dissection, exposing the bluish, fibrous capsule. The kidney is pushed well upward and into the loin by the hand of an assistant pressing on the abdominal wall. Special care should be taken that the kidney be in its normal position. The kidney is secured by passing 4 to 6 sutures through the capsule and about 2 cm. (1 inch) of kidney substance and then through the adjacent fascia and muscles of the wound, tying subcutaneously. Fine silk, kangaroo tendon, and chromicized catgut are used as suture material; but if catgut is used, it should be made certain that it is not too readily absorbable.

After the kidney is firmly fastened in place the external wound is closed and the usual aseptic dressing applied.

A movable kidney may induce disturbances of 3 kinds—pain, dyspepsia or nervous instability, or all combined. When pain and dyspepsia occur, the writer keeps the patient in **bed** for several days. Fixation is unnecessary when the displacement of the kidney forms part of a general tendency to ptosis. General **gymnastic exercises** and **hydrotherapy** to strengthen and tone up the abdominal wall are indicated, resting the sagging abdominal wall by **frequent reclining**. This affords a living abdominal band which is better than all artificial measures. A strong and elastic abdominal wall is one of the best means for restoring a sagging kidney to place. An **abdominal band** may usefully supplement this. Treatment for the nervous instability is helpful for the subjective symptoms. Uteau (Prog. méd., Aug. 30, 1919).

Various modifications of this operation have been suggested, having as their main object the securing of firmer or more general adhesions about the kidney.

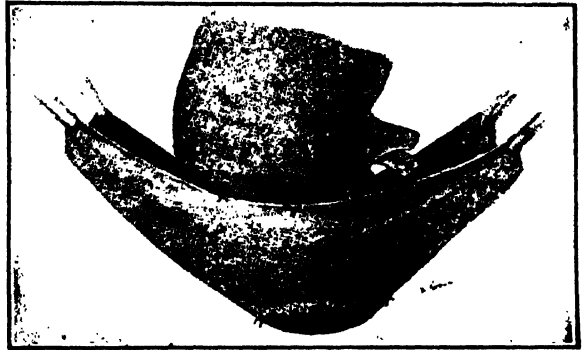
Packing the wound with gauze, in-

cising and stripping back the capsule so as to get a raw surface in contact with the surrounding parts, splitting the quadratus lumborum longitudinally, dividing its lower attachment and making a muscular sling, may be mentioned among these procedures, but simply stitching the kidney in place, as described, has given satisfactory and permanent results in the experience of several prominent surgeons. While the oblique incision is generally recommended, a vertical incision along the sacrolumbalis muscle permits of more ready access for the purpose of securing the kidney in its normal axis.

Important points to be borne in mind while operating to relieve the symptoms produced by dislocated kidney: Do not attempt to "hang" the weight over the "hole" by suspension of the kidney by its capsule or fragments thereof. Never "fix" the kidney through a lumbar incision, working as you must do in the dark without being able to discover adhesions, kinks, etc. Never resort to the unsurgical procedures of removing a portion of the rib; suturing a flap of the capsule over or to the rib; dissecting off a piece of the lumbar fascia to deepen the renal fossa; placing deep sutures or any sutures at all through the kidney substance or its capsule; trying to produce granular adhesions of the peritoneum to the fascia by packing with gauze; or placing sutures and confining the attachment to the lower pole, allowing the kidney to tilt forward and be crushed into that position by the superimposed weight of the liver. Harlan (*Amer. Jour. of Surg.*, Oct., 1909).

Hammock operation: The kidney is laid bare by an oblique lumbar incision and brought into the wound by pressure on the abdomen, so that its lower pole can be fixed with the fingers. A strip of fascia lata, from

18 to 20 cm. long, by about 10 cm. broad, is taken from the thigh, and its four corners secured with artery forceps. An incision about 4 cm. long is made longitudinally in its middle, into which the lower pole of the kidney is introduced, so that the kidney lies in the strip of fascia like a stone in a sling, and is secured in place by sutures passing through the margins of the opening and the capsule. The sling is then fastened in its desired position by sutures. By this means the lower pole can be drawn a little forward, if the upper pole shows a tendency to droop. The advantage



Fascia hammock for wandering kidney. (Kocher.)
(*Correspondenzblatt für Schweizer Aerzte.*)

of this method is that the kidney is kept in place without depending on any sutures in the kidney itself. T. Kocher (*Correspondenzbl. f. schweizer Aerzte*, May 3, 1913).

Experiences in 189 cases of wandering kidneys in which **Rovsing's method** was applied. Decapsulation in connection with suture of the capsule proper is the most reliable procedure while it makes the least demands on the patient. The kidney is drawn up into the incision; the latter skirts the margin of the erector spine, from the tenth rib to 2 cm. below the twelfth, where it turns forward at a sharp angle for 6 or 8 cm. The drawn-up organ is cleared from all adhesions with scrupulous care and the true capsule is incised along the convex margin of the kidney with a short transverse incision at each pole. The capsule is then turned

back on each side, leaving a rectangular opening. A stout silk thread (No. 4 English) is then carried around the lower pole of the kidney, weaving it in and out of the true capsule beyond the area of the incision. This suspends the lower pole as in a sling and the kidney is then restored to place. The ends of the silk are brought out separately each side of the incision in the skin.

When the kidney is thus pushed and drawn up into its normal place, with room for normal play, the patient is turned on his back and is not allowed to get up for four weeks. The threads are removed the third week. In the uncomplicated cases all trouble was permanently at an end after the operation in 85 per cent.; adding to these the improved cases, 95.4 per cent. of the patients were cured or materially benefited. The decapsulation insures adhesions which anchor the kidney firmly in place to the transverse fascia, and not to fat tissue. The parenchyma is left intact. The necropsy in a few cases after death from intercurrent disease and in animals confirmed the reliable outcome. The cases in which symptoms recurred are analyzed, seeking for the cause. One of the patients died from peritonitis, suppuration occurring along the course of the silk. This is the only one of the 4 deaths for which the operation can be held responsible. It suggests that silk impregnated with silver nitrate might be preferable. Scheuermann (*Jour. Amer. Med. Assoc., from Archiv f. klin. Chir., Mar. 24, 1914*).

NEPHROLITHIASIS.—Nephrolithotomy.—The removal of a stone located in the substance, calices, or pelvis of the kidney—is indicated when the diagnosis is reasonably certain. (For the medical treatment see NEPHROLITHIASIS, in the preceding article.)

Technique of Nephrolithotomy.—The preparation of the patient and the incision are the same as for nephropexy.

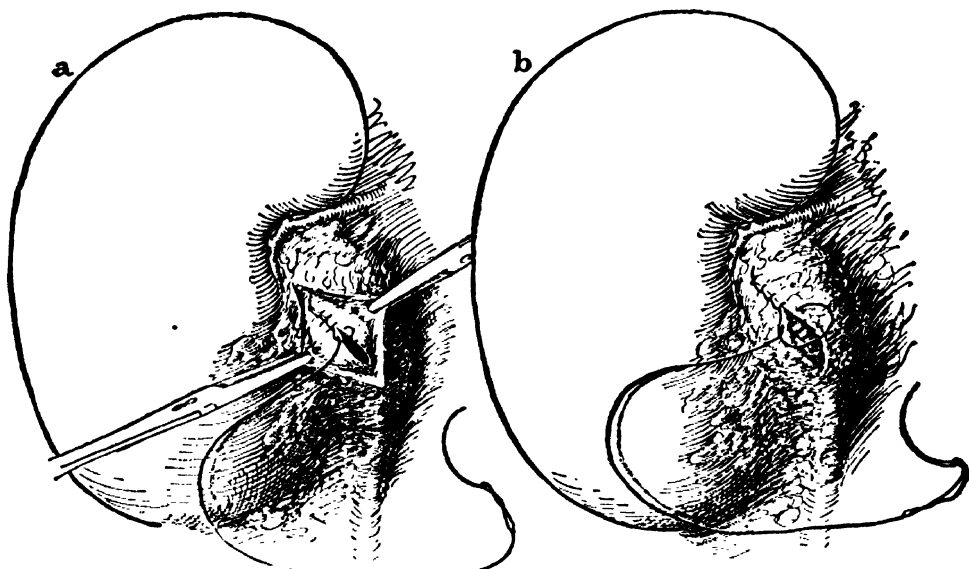
Edebohls's bag, placed under the patient lying on the side, is of much value in bringing the field of operation into prominence. Deep manipulation is facilitated by dividing the last rib, also the outer edge of the quadratus lumborum, or if more room is needed, for inspecting or freeing the kidney or for controlling hemorrhage, the incision may be curved downward and forward toward the abdomen. Free enough exposure to permit delivery of the kidney into the wound greatly facilitates operation. After opening the fatty capsule, the kidney should be systematically examined by pressing on its surfaces or compressing it between the thumb and fingers. Henry Morris recommends that the pelvis and upper end of the ureter be palpated before the kidney is disturbed in order to detect any small calculus that might be present and prevent its falling into the ureter during manipulation. If no hard spot is detected after the entire kidney has been squeezed between the fingers, some operators recommend that exploratory punctures be made from one end of the kidney to the other with a fine needle. This procedure is to be condemned as most unreliable for diagnostic purposes.

In case a stone is found the kidney must be opened, and if none be found the same procedure is necessary for thorough exploration. In either case an incision should be made in the border, in the non-vascular line first mentioned by Hyrtl and recently further emphasized by Brödel's exhaustive studies. Hemorrhage is controlled by compression of the pedicle by assistant and at the close of the exploration by catgut sutures through the kidney substance. Large calculi,

particularly if branched, often have to be broken with forceps before it is possible to remove them. Openings in the pelvis sometimes give rise to urinary fistulæ; when, therefore, it seems feasible, it is best to extract through an opening into renal tissue.

Whether a calculus is found or not, the ureter should be catheterized through the pelvis of the kidney from end to end, to determine that it is not obstructed. In calculous pyone-

The writer recommends the use of **distilled water** in large quantities to prevent recurrence of kidney stone and renal colic. For acute renal colic the use of **morphine** and **atropine** hypodermically, followed by the ingestion of 2-ounce (62 Gm). doses of **glycerin** with large quantities of distilled water, has seemed to be of value in aiding the discharge of the stones spontaneously, especially when the patient was in a very hot bath. Ochsner (Jour. Amer. Med. Assoc., lxxiii, 1105, 1919).



a, Pelvis of a kidney which has been laid open for the extraction of a stone, half closed with a running locking suture of chromicized gut. The fascial layer spoken of in the text is the one drawn aside by the forceps. *b*, chromicized gut or fine black silk suture closing the fascial layer over the line of suturing in the renal pelvis proper. This fascial layer is a little too distinctly defined. (*Kelly*.)

phrosis free drainage is necessary, but in most cases the kidney wound is sutured with buried catgut. The wound is closed, leaving a small drain, and dressed with the usual aseptic precautions.

Probably no major operation has a lower mortality, particularly if undertaken early, before any serious renal changes have resulted.

Cellulitis, renal fistula, and renal abscess have been mentioned as possible consequences of the operation.

Thorough flushing of the urinary channels by **drinking freely of water**, preferably distilled water, may help in the dislodgment and removal of any possible nucleus of future stones. This treatment must be continued a long time, even after the urine has completely cleared up. Leaving fragments of stones at operation may favor recurrence. Lamson (Annals of Surg., lxxxi, 16, 1920).

TUMORS OF THE KIDNEY.

The greater number of tumors of the kidney are malignant. Sarcoma, however, is much the most common

form; carcinoma comes next in order; adenoma is not uncommon and is said to degenerate frequently by epithelial overgrowth into carcinoma; fibroma, lipoma, angioma, myxoma, and tumors of the adrenal are more rarely observed.

Study of early diagnosis of kidney tumors in 265 articles in the literature on the diagnosis of kidney disturbances. None of the modern methods of investigation has equaled in diagnostic importance the classic triad, pain, hematuria, and tumefaction, but many tumors in the kidney run a latent course. In adults hematuria is generally the earliest symptom, but it is rare in children. The bleeding usually continues through the entire micturition; it may begin without apparent cause or pain or may follow palpation or jar from any cause, driving or running. Blood-stained urine may alternate with normal urine. Generally the hematuria is of brief duration. Cystoscopy is important, as even with a palpable tumor the blood may come from the other kidney. The pain with a kidney tumor is described as a dull ache, coming on spontaneously and not influenced by repose or exercise, as a rule. It may radiate from the lumbar region to the liver, abdominal walls, bladder, anus, testicles, or vulva, or into the hips, thighs, shoulders, or breast, in the latter case suggesting intercostal neuralgia, or there may be reflex pain in the other kidney. Pasteau has called attention to some new remote tender points in kidney disease. They are along the course of nerves which issue from the spinal cord at the same point as those which innervate the kidneys. Israel found fever a pathognomonic and sometimes the only symptom of cancer of the kidneys or adrenals free from febrile complications. This was the case in 8.2 per cent. of 146 cases.

- Röntgenoscopy is of not much use in diagnosis of kidney tumors. The absence of cachexia with a kidney tumor of long standing suggests that it

is a hypernephroma. P. Frangenheim (Centralbl. f. d. Grenzgeb. d. Med. u. Chir., May 23, 1912).

Cysts.—Various forms of cysts: simple serous, usually single but sometimes multiple; hydatid cysts; dermoid cysts; and polycystic degeneration, are frequently seen.

The prognosis, according to the writer, is notoriously bad in malignant tumors of the kidney, and the most distressing feature is that it bears little relation to the size and duration of the growth. A very small hypernephroma may invade the vessels and metastasize very early, while a very large one may not metastasize at all. S. Stillman (Calif. State Jour. Med., xv, 363, 1917).

Polycystic degeneration of the kidneys is in almost all instances a bilateral affection. In cases in which, for the time being, one kidney appears to be anatomically and functionally healthy an involvement of this organ may be expected to develop later. Determination of the kidney function is indispensable prior to decision upon any operative procedure. Nephrectomy in cystic kidney is always contraindicated. Excruciating pain, general sepsis caused by suppurations of cysts, profuse hematuria, and distressing symptoms due to the presence of enormously large cysts are, under favorable conditions (good renal function), indications for operative interference. **Nephrotomy** with **puncture** of cysts, **decapsulation**, and **nephrofixation** are the operative procedures which in selected cases may give satisfactory (temporary) results. Kroloszyner (Amer. Jour. Med. Sci., Sept., 1909).

The diagnosis of infected cystic kidney is generally very difficult, as the physician seldom thinks of the possibility of this rare condition. It is peculiarly liable to become infected. Sieber found infection mentioned in 10 per cent. of 200 cases on record, and Borelius in 1 of his 4 cases. Bull calls attention to the family tendency

in his cases; a man and 3 of his 11 children and a brother and sister had cystic kidneys, the diagnosis being confirmed by operation or autopsy. The symptoms came on about the age of 24, and none of the third generation has reached this age yet. Notwithstanding that the tendency to cystic kidney is bilateral, as a rule, if one kidney is predominantly affected while its mate is still functionally capable, nephrectomy may be indicated.

The Scandinavian literature on the subject and Sieber's monograph show that in only 9 of the 200 cases was only 1 kidney involved, as determined at autopsy; both were involved in 150. In about 12 per cent. of all the cases the lesion had never induced appreciable symptoms. The urine may be normal, but generally is like that with contracted kidney. The renal region is usually tender and there may be vague or sharp pains, constant or paroxysmal. Intermittent hematuria was observed in 20 per cent. of the cases, hypertrophy of the heart in 50 per cent., and a hemorrhagic tendency was frequently apparent, apoplexy even in the young, epistaxis, intestinal hemorrhage and hemoptysis. **Nephrectomy** was done in 61 cases, with 20 fatalities; 8 of the patients are still living after from three to seven years. **Nephrotomy** was done in 10 cases, on both kidneys in 4, with 2 fatalities. Bull (Jour. Amer. Med. Assoc., from Norsk Mag. f. Lægevidenskaben, Aug., 1910).

Report of 3 cases of polycystic kidney in which the distressing symptoms were greatly relieved, and the life of the patients apparently prolonged, by exposing the more affected kidney and performing multiple **puncture** of the cysts. Since the condition is practically always bilateral, nephrectomy is, except in rare instances, positively contraindicated, and yet severe pain, oliguria, and other severe symptoms demand intervention. Rovsing (Amer. Jour. of Urol., vol. viii, p. 120, 1912).

Sarcoma is by far most frequently met with in children and is usually congenital. The tumor is generally of the round or spindle-celled variety, highly malignant, of rapid growth, and often attains enormous dimensions.

Personal case of sarcoma of the kidney discovered at autopsy in a female child 14 months old, as did a review of the subject generally, lead the author to conclude that sarcoma of the kidney may exist without symptoms, and generalization may occur early, before the kidney is greatly enlarged. In the writer's case appearance of the anemia and rapid loss of flesh were coincident with generalization of the growth. La Pierre (N. Y. Med. Jour., Jan. 18, 1908).

Case of recurrent lymphosarcoma of the kidney which originally was a hypernephroma that had taken on a fatty change accompanied by a limited malignant tendency. G. McConnell (Jour. Med. Research, Oct., 1908).

Sarcoma of the kidney in infancy is exceedingly rare. It is of very rapid growth, does not cause cachexia until it is very large, causes little or no pain or disturbance of the general health, and is usually first discovered by accident on account of change in the contour of the abdomen. Hematuria may or may not be present. Such tumors lie behind the colon; they begin at one side, but grow downward and inward, other abdominal tumors being more centrally located from the start. They are also hard, firm, and fixed. The mortality from operation is high, and recurrence is not infrequent, but it is the only treatment which offers a shadow of hope. Cheney (Arch. of Pediat., Apr., 1908).

Case of adenosarcoma of the left kidney in a child 3 years and 5 months old. As the right kidney, upon cystoscopy, proved to be in good condition, the left kidney was **enucleated**. The operation was suc-

cessful, and the little patient recovered. Pedersen (Med. Rec., Aug. 26, 1911).

Carcinoma is said to result in some cases from traumatic irritation, as from calculi, or to follow inflammatory processes. As a rule, the tumor is of slow growth, and the neighboring lymphatic glands are not affected until late. Extension of the disease to surrounding organs is not common and metastases are still more rare. All these factors favor the success of the operation. If a malignant growth be large and of some months' standing, however, particularly if it is adherent, operation is contraindicated, as it is also in children unless the growth be small and the child otherwise healthy.

SYMPTOMS.—Renal growths frequently give no symptoms, remaining latent for some time. Tumor, pain, and hematuria are most important symptoms. The tumor is situated in the loin, growing anteriorly; is smooth and rounded, resists movement on pressure, and does not descend on inspiration. Pain is quite a constant symptom in adults. It is usually dull, aching, felt chiefly in the loin, but may be lancinating, radiating to the scapula and back and to the thigh. Hematuria may be the first symptom, particularly in case of sarcoma, and is irregularly intermittent. Carcinomatous tumors are apt to be nodulated instead of smooth and rounded, as are most renal tumors. In advanced stages of the disease fragments of carcinomatous tissue may be passed in the urine. The patient becomes emaciated and cachectic. Hepatic and splenic enlargements are most likely to be confounded with renal tumors.

DIAGNOSIS.—The differential diagnosis is facilitated by noting the resonance of the colon, which crosses the kidneys, but not the spleen or liver. This is assisted by the detection of the notched edge of the spleen or well-defined edge of the liver, and of dullness on percussion over the flanks. Soft, elastic sarcomata may be mistaken for hydronephrosis.

The symptoms of a renal growth vary to a certain extent with the nature of the tumor present. The three prominent symptoms of hypernephroma are hematuria, pain, and the presence of a renal tumor. *Hypernephroma* is most common between the ages of 50 and 70 and is of comparatively slow growth; sarcoma is more common in childhood and forms a rapidly growing tumor with early cachexia. *Carcinoma* is a disease of later life, gives rise to more pain, and usually to constant hematuria; whereas in sarcoma hematuria may be absent, and in hypernephroma is usually of an intermittent type. Glandular enlargement is more common in carcinoma, either about the kidney or in distant glands, whereas a pulmonary or osseous deposit is more usual with hypernephroma. R. H. J. Swan (Lancet, Feb. 8, 1913).

Case of epithelioma developing in a kidney subject to hydronephrosis.

Nephrectomy was done in 2 months, with smooth recovery. Lagarde (Jour. d'Urol., Mar., 1918).

GENERAL SURGERY OF THE KIDNEYS.

When operative procedures are about to be performed on the kidney, the fact that it is occasionally the seat of anomalies should be borne in mind. It may occupy an abnormal position; under such circumstances it will usually be found below and nearer the middle line than usual. It may even be found as low as within the pelvic

cavity. Irregularities of size and shape may also be found, due to abnormal or arrested development.

Sometimes the extremities fuse, forming "horseshoe kidney," or one kidney may be absent, in which case the other is apt to be of unusual size, as we have seen. Again, cases of congenital occlusion of the ureter have been reported, in which it was, of course, impossible for the kidney to fulfill its function.

RENAL DECAPSULATION.—The proposal to treat chronic Bright's disease by operation was first made by Edebohls (Medical Record, Dec. 21, 1901), who described the operation as follows: The patient is placed prone upon the table, with the author's kidney air-cushion underlying and supporting the abdomen. Both kidneys are thus rendered accessible to operation without the necessity of changing the patient's position. An incision is carried from the twelfth rib to the crest of the ilium along the outer margin of the erector spinæ, without opening the sheath of that muscle. The fibers of the latissimus dorsi muscle are bluntly separated in the direction of their course, without cutting. The iliohypogastric nerve is sought for and drawn to one side or other, out of the way of harm. Division of the transversalis fascia exposes the perirenal fat. This is divided over the convexity of the kidney until the capsule proper is reached. The fatty capsule is now bluntly separated everywhere from the capsule proper, the dissection advancing on either aspect and around both poles of the kidney until the pelvis of the kidney is reached. Now and then the fatty capsule may be found so thickened and adherent,

as the result of chronic perinephritis, that the scissors or knife may be required to separate it from the capsule proper. The kidney with its capsule proper is next lifted from its fatty capsule bed, and if possible delivered through the wound. The capsule proper is divided on a director along the entire length of the convex external border of the kidney, and clean around the extremity of either pole. Each half of the capsule proper is in turn stripped from the kidney and reflected toward the pelvis until the entire surface of the kidney lies raw and denuded before the operator. In separating the capsule proper from the kidney, care must be exercised not to break or tear away parts of the kidney, which is often both very friable and very firmly connected with its capsule proper. The stripped-off capsule proper is next cut away entirely, close to its junction with the pelvis of the kidney, and removed. Delivery of the kidney makes this otherwise difficult work easy. If the kidney cannot be delivered, the capsule proper must be entirely peeled off the kidney by the fingers in the bottom of the wound, and excised as far as possible, any remaining portion being simply reflected backward around the root of the kidney, where it will curl up and stay. The kidney is dropped back into its fatty bed and the external incision is closed.

The results obtained by the various observers who have tried the operation, its indications and contraindications have been reviewed in the article on BRIGHT'S DISEASE, Vol. II. In the experience of many competent surgeons, however, the operation has not given the results expected and it has been abandoned by many of them.

NEPHROTOMY.

Nephrotomy is an incision into the kidney, and is used for **exploration, removal of stone, relief of nephralgia,** as a preliminary to **plastic operation for hydronephrosis or pyonephrosis,** or for the evacuation of **cystic or purulent collections of fluid.**

In place of incision, which is usually accompanied by somewhat free bleeding, Cullen and Derge pass a blunt needle carrying No. 3 silver wire through the substance of the kidney in the non-vascular zone and by gentle seesawing the wire cuts out. Animal experiments show reduction of hemorrhage to less than half by use of this method.

The operation may be indicated in **simple cysts, hydronephrosis, hydatid cysts, pyonephrosis, suppurative nephritis, and tuberculosis of the kidney.**

In all of these conditions pus and blood will be found in the urine. The amount of blood is generally small and the cells are abnormal; the pus, if measured, is apt to vary in amount. Renal cells and the characteristic epithelium of the pelvis of the kidney will also probably be found. In all chronic inflammatory conditions casts and albumin are present in the urine. Elevation of temperature with or without chills, loss of appetite, hectic suppression of urine, and uremia may also exist. There will be more or less pain and tenderness over the region of the kidney, and in pyelonephritis and pyonephrosis there may be considerable swelling, redness, and edema. The symptoms of pyonephrosis are those of hydronephrosis plus those of suppuration.

Cysts.—*Simple cysts* of the kidney begin in the renal cortex and grow

toward the surface without affecting the renal tissue, unless they grow to great size, when they may cause pressure atrophy. They are thin-walled, globular, and of varying size, and they contain a pale, straw-colored, albuminous fluid of low specific gravity. They sometimes contain cholesterol or blood, and rarely the contents are thick and jelly-like. They usually cause no symptoms except those of a growing cystic tumor in the loin.

Hydatid cysts are found more frequently in the kidney than in any other organ except the liver, but are six times less frequent than in that organ. They are usually situated in the secreting substance and tend to rupture into the pelvis without reaching great size. Thinning and atrophy may result, however, from pressure. They may be secondary to hydatid disease of other organs.

In some cases a tumor may be felt on palpation, and fluctuation may be perceptible; hydatid fremitus, as observed in other organs, is rare. If the cyst ruptures into the renal pelvis, the passage of vesicles through the ureter gives rise to symptoms of renal colic. The presence of vesicles and hooklets in the urine would confirm the diagnosis. Blood and pus may also escape with the hydatids.

Hydronephrosis is a distention of the kidney with fluid, caused by an obstruction to the outflow of urine.

A tumor, rounded or lobulated in form and often fluctuating, may usually be felt in the lumbar region. In case this tumor diminishes in size or disappears at times, especially if the diminution or disappearance is accompanied by a profuse flow of urine of low specific gravity, the diagnosis

is almost certain. Severe cases may be accompanied with suppression of urine, and, in case both kidneys are affected, uremia will occur sooner or later. Pain is a variable symptom; it is influenced by the tension and may be wanting.

Its causes are congenital or acquired. Nearly one-third of all cases are said to be due to some abnormal condition of the ureter: impacted calculus, kinks, twists, stenosis, or compression from some abnormality of adjacent structures, such as tumors of the abdominal or pelvic organs. Floating kidney is a frequent cause of kinks of the ureter. Among other unusual causes have been mentioned enlarged prostate, phimosis, and retroflexion of the uterus. The fluid within the cyst is never pure urine, frequently containing neither urea nor uric acid: it is usually a clear fluid of low specific gravity containing chlorides and albumin; sometimes it is brownish from the presence of blood; it may be putrid and ammoniacal; rarely it is thick and jelly-like.

Pyelitis and **pyelonephritis** both occur most frequently as the result of secondary infection from some disease lower down in the genitourinary tract. If the infection is confined to the pelvis of the kidney it is known as pyelitis; if the kidney substance is affected, pyelonephritis, and in its typical form it is usually called "surgical kidney." Both kidneys are generally affected, and gonorrhea is the ordinary cause of the infection. Calculus is also a very common cause of these conditions, or a calculus may form as a result of the inflammation.

Pyonephrosis.—The suppurative processes in a case of pyelonephritis may go on until the greater part of

the kidney substance is destroyed and only a sack filled with pus remains; this condition is known as pyonephrosis. An after-development of supuration in hydronephrosis produces the same result. (See also article on KIDNEYS, DISEASES OF.)

Renal abscess may result from traumatism, renal calculus, or it may be pyemic or metastatic in origin. Abscesses of the kidney are located in the cortical substance. They frequently empty through the pelvis of the kidney or they may rupture the capsule, giving rise to a perinephritic abscess in the surrounding cellular tissue. In case there are several abscesses the septa between them may break through, giving rise to pyonephrosis. (See also article on KIDNEYS, DISEASES OF.)

Tuberculosis of the kidney is, in the majority of cases, associated with tuberculosis in other organs. The kidney is enlarged, sometimes very considerably, and cheesy masses are seen in the secreting substance. (See also article on KIDNEYS, DISEASES OF.)

Perinephric abscess in most cases results from the extension of suppurative processes in the kidney itself, but it may follow traumatism with or without recognizable injury to the kidney; it may be metastatic in origin following typhoid fever, grip, measles, or peripheral suppurations, or it may result from operative intervention or inflammatory processes in neighboring organs. Not seldom it arises from a local infection of the perinephric tissues.

The abscess tends to burrow along the sheaths of muscles and under the fasciæ of the lumbar region, usually reaching the surface, but sometimes following the sheath of the psoas to

the inguinal region, or finding its way through the diaphragm or rarely bursting through the peritoneum.

The symptoms are those of deep-seated suppuration in this region, but the condition is apt to be of particular gravity because of the debilitated condition of the patient from the previous renal suppuration and the highly poisonous character of the mixed pus and urine. The diagnosis may be confirmed by the use of an aspirating needle. (See also article on KIDNEYS, DISEASES OF.)

TREATMENT.—In any of the above conditions the operation may be indicated. Small cysts are frequently found in granular kidneys, however, which never demand surgical treatment, and in case pathological changes are far advanced in any of these conditions the operations of **resection** or **nephrectomy** may offer the patient the best chance of recovery. **Puncture of the kidney** and **aspiration** of the contained fluid is recommended by some surgeons in the treatment of *cysts* and *hydronephrosis*, but, if successful, the procedure has to be frequently repeated in most cases and it very often fails to produce a cure or gives rise to infection.

The indications are more positive when there is *suppuration* in and around the kidney; **incision, evacuation of the pus, and drainage** are necessary. When the diseased condition has advanced so far as to call for nephrectomy, but in which the strength of the patient is much exhausted, incision and drainage are often followed by such gain in strength and improvement of the patient's general condition as will permit of the successful performance of the more seri-

ous operation at a later date. In *tuberculosis of the kidneys* simple **nephrotomy** with **removal of diseased tissue** may be all that is needed; but **nephrectomy** is often necessary.

Technique.—Before all operations of probable gravity examination of the urine to determine the functional capacity of the kidneys (see NEPHRECTOMY), and if possible the condition of the other kidney should be made. In order to lessen the danger of infection from the micro-organisms which are commonly found, even in healthy kidneys, hexamethylenamine or some of the proprietary drugs of like chemical composition may be administered for several days before the operation.

The usual incision for exposing the kidney (described above) is generally the best. In cases of great enlargement, however, it may be more convenient to make the opening farther forward. In operating for cysts or for hydronephrosis the tissues may be found normal, with the exception of a thinning of the perinephric fat; but in suppurative processes the skin, muscles, and fasciæ are likely to be found vascular and edematous, and the perinephric fat dense and adherent. A sufficient surface is usually denuded to permit of its being brought to or near the level of the skin, where it is sutured after being opened. Any curdy or stringy material which may be found within abscesses should be curetted away, and if there are septa between abscesses they should be broken down. After thorough disinfection of the wound a thick drainage-tube is inserted, the wound is partly closed, and a heavy absorbent dressing applied.

Simple cysts often close primarily,

the cavity of an hydatid cyst usually closes after suppuration, and there are a good proportion of cures following nephrotomy for abscess. After operations for hydronephrosis, *fistulae* are often left that will not close without a **plastic operation** or, in some cases; **nephrectomy**. **Resection** or **nephrectomy** is frequently called for after nephrotomy for tuberculous kidney.

NEPHRECTOMY.

Removal of the kidney may be indicated in cases of **renal tumor**; **severe injuries accompanied by serious hemorrhage, suppuration, or infiltration of urine**; in renal or ureteral fistulae, **diseased movable kidney, tuberculosis of the kidney, hydronephrosis, calculus, cyst, and suppurative processes** in which resection seems unlikely to relieve or cure.

But few well-authenticated cases are on record in which this operation was undertaken for injuries of the kidney. While a successful result may follow without intervention, operation has, no doubt, often been delayed until too late. Severe hemorrhage—as evidenced by bloody urine, acute anemia, and the physical signs of fluid in the abdominal cavity—is an indication for immediate exploratory operation. The same is true in the event of severe secondary hemorrhage, which sometimes occurs as the result of the rupture of a traumatic aneurism. It is often difficult to decide what to do if the bleeding is less copious, but in any case operation should not be deferred until the patient is too weak and anemic. In the less severe cases the lumbar incision will answer; in graver injuries the extraperitoneal incision from the tip of the twelfth rib to the junction of the middle and outer thirds of Poupart's

ligament will give more room and seems more generally applicable; celiotomy is called for in case there are signs of hemorrhage into the abdominal cavity. The ligation of vessels and suturing or the use of the tampon followed by suture may be sufficient in less severe injuries, but nephrectomy is indicated in case a main branch of the renal artery is injured or if there is very extensive laceration and contusion of the renal substance.

The conditions under which nephrectomy is indicated—for *renal calculus, hydronephrosis, tuberculosis, cysts, and suppurative processes*—have already been discussed.

Ureteral fistulae, which usually are due to wounds inflicted during operations on the abdominal or pelvic viscera, may necessitate **nephrectomy**, but the operation seems indicated only in case there is great discomfort or the patient is prevented from following a necessary occupation. In most cases it would probably be possible to perform a **plastic operation** on the ureter or, failing in this, to **implant the end of the ureter into the rectum**.

Technique.—As a preliminary to the removal of a kidney measures should be taken to determine as definitely as possible whether another kidney exists and whether it is sound or diseased. Numerous segregators and other devices have been suggested for the purpose of collecting the urine from each kidney separately, many of them depending upon the compression of the ureter by various means, but none of them have proved entirely satisfactory. The catheterization of the ureters (see below, DISEASES OF THE URETERS) is the most certain method

of obtaining separate urines, but much special skill is required for its successful practice.

Among the possibilities for false conclusions resulting from ureteral catheterization may be mentioned plugging of the catheter by a small clot or by pus; reflex anuria from the presence of the catheter in a few cases or polyuria for a few minutes in most cases which may resemble the flow from retention; also appearance of a few blood-cells from traumatism in the first urine.

In some cases it may seem necessary to lay both kidneys bare by lumbar or abdominal incisions to determine the presence of both kidneys or the extent of disease in them, as recommended by Edebohls and Kocher.

The kidney may be removed either through a lumbar or an abdominal incision. Abdominal nephrectomy is usually reserved for those cases in which there is great enlargement of the kidney and for cases of injury in which there is hemorrhage into the peritoneal cavity. The lumbar incision gives better opportunity for the separation of adhesions, it is extraperitoneal, and permits freer drainage of abscesses if necessary without serious danger of peritonitis, and the general mortality is considerably less than after abdominal nephrectomy.

The great point in the ordinary method of dealing with the pedicle is to avoid including in the ligature any portion of the kidney pelvis. When, however, the pelvis is greatly dilated, with many vessels spread out over its circumference, all these long vessels crossing the dilated pelvis require to be seized with hemostatic forceps and tied separately with thin silk. Bland-Sutton (Surg., Gynec., and Obstet., Jan., 1908).

Series of cases, including every case of **nephrectomy** in which the writer has personally operated, without any effort being made to select favorable cases, have demonstrated that the old ideas regarding the danger of nephrectomy *per se* are exaggerated, and that with our modern methods of examination the kidney can be removed in suitable cases with comparatively little risk to life. Brewer (Med. Rec., Mar. 20, 1909).

The kidney was removed on account of tuberculosis in 90 of the 100 **nephrectomies** reported by the writer. Once convinced of the integrity of the other kidney, he did not hesitate to remove the tuberculous organ even when the general condition was extremely bad, and the results were favorable. His mortality was 4 per cent., but only 2 of the cachectic patients succumbed, one to advanced myocarditis and the other to uremia. Wildholz (Correspondenzbl. f. schweizer Aertze, Oct. 15, 1909).

In his technique for **nephrectomy** when there is sclerosis of the hilum and vessels, Tausini applies a clamp to the hilum, including the large vessels and the ureter, and ligates here. Among his 47 operations of the kind he lost only 1 patient and this in 1875, his mortality thus being only 2.12 per cent. This technique also materially shortens the operation. D'Este (Annales des mal. org. génito-urin., July 15, 1910).

Nephrectomy does not seem to affect the course of pregnancies later. Andrews has reported a case in which the woman passed through 5 pregnancies after nephrectomy, and Hartmann has reported 150 pregnancies in 115 women after nephrectomy, with only 3 deaths; in 2 of the fatal cases the remaining kidney was known to have been diseased. In their 3 personal cases there was no trace of albuminuria at any time during the pregnancy, delivery occurring without difficulty from 20 months to 3 years after the operation. Spire and Boeckel (Annales de gynéc. et d'obstét., Mar., 1913).

A large proportion of patients in whom **nephrectomy** has been performed for severe lesions die during the first year following operation. The majority of cases of renal tuberculosis in which the remaining kidney is more or less involved succumb before the end of four years. On the other hand, patients operated on for tumor or tuberculosis who survive for four years may be regarded as cured. The presence of slight or moderate signs of pyelitis or pyonephritis in the kidney of a nephrectomized person is of no especial moment, as they are apt to disappear after operation. Kümmell (*Arch. f. klin. Chir.*, Bd. ci, 11ft. 2, 1914).

The writer reports 250 cases of **nephrectomy** based on the findings in catheterization of the ureters and 187 cases based on the findings of the Ambard ureosecretory index. With the latter below 0.100, the mortality was 3.6 per cent.; above 0.100, the mortality was 40 per cent. With catheterization alone, the mortality was 3.20 per cent.

His experience is in favor of the Ambard index as being a reliable guide alone, especially when it is below 0.100. The higher the constant the greater the risk.

The risk is highest when the nephrectomized kidney has been doing part of the work.

With a constant below 0.100 the disease was invariably restricted to one side. Leguen (*Jour. d'Urol.*, ix, No. 1, 1920).

Lumbar Nephrectomy.—The length and direction of the incision depend to some extent on the condition of the organ to be removed. In case the kidney is of normal size or but slightly enlarged and is not adherent the vertical or oblique incision as described under movable kidney could be used for the removal of an enlarged or adherent kidney. The incision, beginning $\frac{1}{2}$ inch below the last rib near the outer border of the erector

spinæ and continued first downward toward the crest of the ilium, then curving forward to the middle third of Poupart's ligament, gives the necessary exposure for safe operation. Kocher uses this form of incision and finds it possible through it to examine the other kidney or the under surface of the liver with his hand in the abdominal cavity. After determining that the other kidney is sound he sews together the opening in the peritoneum and proceeds with the removal of the diseased kidney.

The structures divided and their relations have already been described under movable kidney. It is generally possible to separate the peritoneum from the surface of the kidney and to push it inward. The organ is then freed from its bed and the larger vessels going to the capsule are tied. Dense adhesions are divided by scissors, but in some cases they may cause so much difficulty that it will be easier to enucleate the kidney from its capsule rather than to separate it from the circumrenal fat. After it is freed the organ is luxated from its bed, care being taken not to make much traction on the pedicle; the structures at the hilum are isolated, a strong silk ligature is passed about the vessels by an aneurism needle and tied, the ureter is separately doubly ligated and tied, and the pedicle divided.

If the ureter contains infectious material it may be divided with the thermocautery and pure **carbolic acid** injected, as suggested by Howard Kelly. After the pedicle has been carefully inspected in the wound and all bleeding points have been secured a large drainage-tube is placed in the bottom of the cavity and the

wound is partly closed by deep and superficial sutures.

Abdominal Nephrectomy.—Various incisions have been used: An incision in or near the median line will facilitate the exploration of the alternate kidney in case manual examination seems necessary, while the removal of an adherent kidney would be easier through the lateral incision. After opening the abdominal cavity the kidney is exposed by tearing through the peritoneum forming the outer layer of the mesocolon, as its inner layer contains the vessels which supply the bowel, and their division might give rise to gangrene of the intestine. The freeing of the kidney from its bed and the isolation and ligation of the vessels and ureter are then carried out in much the same manner as in lumbar nephrectomy.

The mortality of nephrectomy varies with condition of the patient and the pathological condition for which the operation is undertaken. The prognosis in operations for malignant disease is grave both as to immediate mortality and permanent cure, but there has been great improvement in results with more accurate methods of determining the functional capacity of the kidney and with improved operative methods and technique. The immediate mortality has been reduced from nearly 70 per cent. in the first decade of renal surgery to 25 per cent. or even less in the experience of some surgeons, at the present; permanent cures of from 2 to 18 years are shown in 34 cases reported by Wagner. The proportion of deaths after operations for tuberculosis of the kidney is also much lower in recent years; probably somewhat better than 10 per cent. in the

hands of experienced surgeons; recent statistics place the mortality at about 25 per cent. in case of traumatic lesions, while with less extensive injuries treated by suture and packing there is probably less than 5 per cent.

RESECTION OF A PART OF THE KIDNEY.—The first partial excision was performed by Czerny in November, 1887, for an angiosarcoma. The operation has been rather rarely resorted to, although there seems to be no doubt that it is a sound surgical procedure in the conservative surgery of the kidney to substitute this operation for total nephrectomy when only a part of the kidney is diseased or has been injured.

Nephropexy, or Nephrorrhaphy, and Nephrolithotomy, being only indicated in special disorders, are described above under the heading of the latter.

TRANSPLANTATION OF THE KIDNEY.

This operation has been successfully done on animals by several workers in laboratories of experimental surgery. It seems to be possible to transplant the kidney to some other part of an animal's body, but not to transplant from one animal to another of the same species and still less practical to transplant from one animal to another of different species. A number of the most prominent workers in this field, in attendance at the recent International Congress of Surgeons, were entirely agreed as to the impracticability of heteroplastic or even homoplastic transplantation at the present state of our knowledge.

An animal—dog—which has undergone a double nephrectomy and the grafting of both kidneys from another animal can secrete almost nor-

mal urine with his new organs and live in good health at least for a few weeks. Carrel (*Jour. of Exper. Med.*, Jan., 1908).

A dog, after having undergone a double nephrectomy and the replantation of one kidney, lived in excellent health for almost two and a half years, and died of an intercurrent disease which was without relation to the operation. The autopsy showed the kidney to be normal. Hence the experiment proves definitely that the extirpation of the kidney in the dog, its perfusion with Locke's solution, the complete interruption of its circulation for fifty minutes, and the suture of its vessels and ureter do not interfere with its functions, even after a long period of time. It indicates finally that from a purely surgical standpoint the grafting of organs is a real possibility. Carrel (*Jour. of Exper. Med.*, Aug., 1911).

Findings in 3 dogs after transplanting one of the animal's kidneys to some other region. The operation proved a success in only one instance; the left kidney had been transferred to the neck and connected with the primary carotid artery and the external jugular vein with the ureter sutured to the skin. The kidney kept up its functioning, but showed signs of mild inflammation when the animal was killed two months later. It had evidently become infected through the ureter from the skin. A kidney from other dogs was transplanted into the animal in 9 other experiments. The results at first were excellent, the kidney functioning nearly normally, but the implanted kidney was absorbed in time or it sloughed away. Attempts to transplant a kidney from a cat to a dog, goat to dog, etc., invariably failed. Villard and Perrin (*Jour. Amer. Med. Assoc.*, from *Lyon chir.*, Aug., 1913).

Study of the manifestations of life of the transplanted kidneys to ascertain whether it could meet increased demands. Histological examination showed that the successfully

transplanted kidney possessed, in a normal manner, the most delicate and sensitive structures in which lay the power of function. When the secreting cells lost their activity, the granules disappeared before anything else. For a permanent normal secretion the proper proportion of the normal constituents must be preserved and for this the nervous influence is necessary. As to the functional capacity of the tubular and vascular portions of the kidney, the investigations showed that there was no considerable deviation from the normal in the activity of the transplanted kidney. Lobenhoffer (*Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, Bd. xxvi, S. 197, 1913).

By vascular suture the writer was able to remove the dog's kidney, and later replace it. The function of such a kidney showed initial overaction, as compared with the normal kidney, followed by balanced action. A single, reimplanted kidney is able to maintain normal life indefinitely. Quinby (*Jour. Exper. Med.*, Apr., 1916).

DISEASES OF THE URETERS.

Examination of the Ureters.—*Inspection.*—The vesical orifices of the ureters can be seen by cystoscopical examination, but for more extensive examination vaginal or abdominal incision is required. For exposing the vaginal portion of the ureter Kelly makes an incision extending from the vault halfway down through the anterolateral vaginal wall. The posterior pelvic portion and lower abdominal portion are exposed after abdominal incision by drawing the sigmoid flexure toward the right to expose the left ureter, and by lifting the caput coli and drawing it also to the right to expose the right ureter. The abdominal portions are exposed by incising the peritoneum reflected over the ascending or descending colon on the outer side, where there

are no vessels, and then displacing the colon toward the median line. The ureter will often be found adhered to the peritoneum as it is separated from the abdominal wall.

Palpation.—The pelvic portion of the ureter may be palpated through the vagina or rectum. If the internal iliac artery can be located the ureter will be felt as a flat, yielding cord lying behind and close to it in the upper part of its course. In the lower part of its course it is distinguished by its direction, size, consistency, and mobility. In case the ureter is thickened or if it be distended or sensitive from disease, it can be much more readily found, and it may be possible to palpate it in any part of its course.

Catheterization of the ureters was practised by Simon, of Heidelberg, in 1875, but with only qualified success.

It is chiefly through the work of Howard A. Kelly that this most important means of investigation has been simplified and brought into general recognition, and it is not only a means of diagnosing disease of the ureter, but a most valuable aid in determining the exact condition of the renal pelvis or of the kidney, in treating disease of the pelvis of the kidney, and in accurately locating the ureters so that they may be avoided in pelvic or abdominal operations.

A general anesthetic is not necessary unless the patient is very nervous. After having emptied the bladder the woman is placed in the knee-chest position or in the dorsal position with the hips elevated. In case it is necessary to dilate the urethra, its sensitiveness is first dulled by the introduction of a pledget of cotton saturated with cocaine, then a well-lubricated, conical dilator is inserted

with a boring motion until a dilatation of 1 cm. in diameter is reached. A cylindrical speculum provided with an obturator is then introduced, the obturator is withdrawn, and air rushes in and distends the bladder.

Light is directed through the speculum into the bladder by a head-mirror and the speculum is withdrawn a little and moved right or left until the ureteral orifices are brought successively into the field. The orifice usually appears as a little transverse slit, with a slight horseshoe-shaped elevation around it, open on the inner side. Sometimes it appears as a pit or hole in the mucosa or as a rosette with an opening in the center. If the observation is continued a little jet of urine will spurt from the orifice for a second or two.

Various types of cystoscopes carrying small electric lights are preferred by many genitourinary specialists and are most practical for study of ureteral conditions in the male. Some distend the bladder with air, others with some solution, and nearly every active worker in this field has his own special cystoscope introducing some features which he considers essential.

The catheter is passed through the speculum until its point rests in the ureteral slit, and it is pushed gently in and toward the side, stopping at once if the slightest resistance is met. The catheter can be introduced even into the pelvis of the kidney and the renal pelvis can be irrigated. Kelly has used a flexible ureteral catheter tipped with wax, which is softened by olive oil, in the diagnosis of calculus in the pelvis of the kidney. The stone makes scratches on the glistening surface of the dental wax which are readily seen with a hand-lens.

Technique of catheterizing the ureters: The first point to be considered is the necessity of finding the opening of the ureter rapidly. It is this necessity for quick action that makes it imperative to have a regular plan and not to wander aimlessly with the cystoscope in the bladder. Unnecessary movements of that instrument will cause contraction of the bladder, which not only make the work difficult, but also delay the examination and make the patient nervous. The best way is first to look for the region where the ureters are expected to be found, and not for the openings themselves. For this reason we first look for the trigone, which can be recognized by the difference in color which it presents as compared with the rest of the bladder. Having found the base of the trigone and holding the cystoscope in the middle, with the beak pointing down, one should next turn the shaft upon its long axis to the right or to the left. Very soon one comes across the angle of the base of the trigone, and in this angle we find the opening of the ureter. Care must be taken, however, that the cystoscope does not move away from the neck of the bladder, which is situated at the upper end of the visual field, and also to see that the motion of the instrument takes place without any sudden jar. Having thus found one opening, it is now necessary to put the cystoscope in such a position that the catheter can enter easily. The orifice should appear as sharp and as large as possible. The catheter must be so placed as to be vertically above the ureteral opening. This is recognized by the fact that the opening which appears as a slit when looked upon at an oblique angle becomes rounded or oval as soon as the prism is placed in a parallel plane with it. If this precaution is neglected, we run the risk of having the catheter slip over the opening instead of entering it. Most of the failures of students are due to the fact that they do not place the instrument in such a position as to allow the

catheter to enter easily. The instrument should be manipulated until the opening appears as large and round as possible, but the movement should be arrested when one finds that deeper shadows are developing in the visual field or that the mucous membrane is becoming indistinct. In this position it is usually easy to enter the opening with the catheter with the aid of the appliances furnished with the cystoscope. H. Loenstein (*Med. Review of Reviews*, from *Med. Klinik*, Apr. 23, 1911).

Palpation of the ureters should be a part of every vaginal examination. Ureteritis, because of the nerves irritated, might simulate disease of any of the abdominal organs. The ureters are marked on the anterior wall by the ureteral ridges, and can be felt from their entrance into the bladder to the pelvic brim. In ureteritis, periureteritis, stone, pyelitis, and tuberculosis, the ureter is thickened and tender. Ureteritis and periureteritis are commonly due to infection from the cervix, and may follow hysterectomy. Palpation shows a thickened tender ureter with intense desire to urinate. Treatment should be applied to the cervix and parametrium and not to the bladder. Tovey (*Amer. Assoc. Obstet., Gynec. and Abd. Surg., Medical Record*, Oct. 30, 1920).

CALCULI IN THE URETER.

These are found most frequently at the junction with the renal pelvis; less commonly about the middle and at the entrance to the bladder.

SYMPTOMS.—Calculi in the ureter usually give rise to attacks of renal colic, whether they simply pass without impaction or become arrested in their course. Impacted calculi are apt to give rise to hydronephrosis, particularly if imbedded near the renal pelvis. At times there is pain or tenderness on pressure at some point in the course of the organ. In the

lower part of the ureter a stone may sometimes be felt by the finger in the rectum or vagina. A positive diagnosis can be made by use of the X-ray or celiotomy and direct palpation.

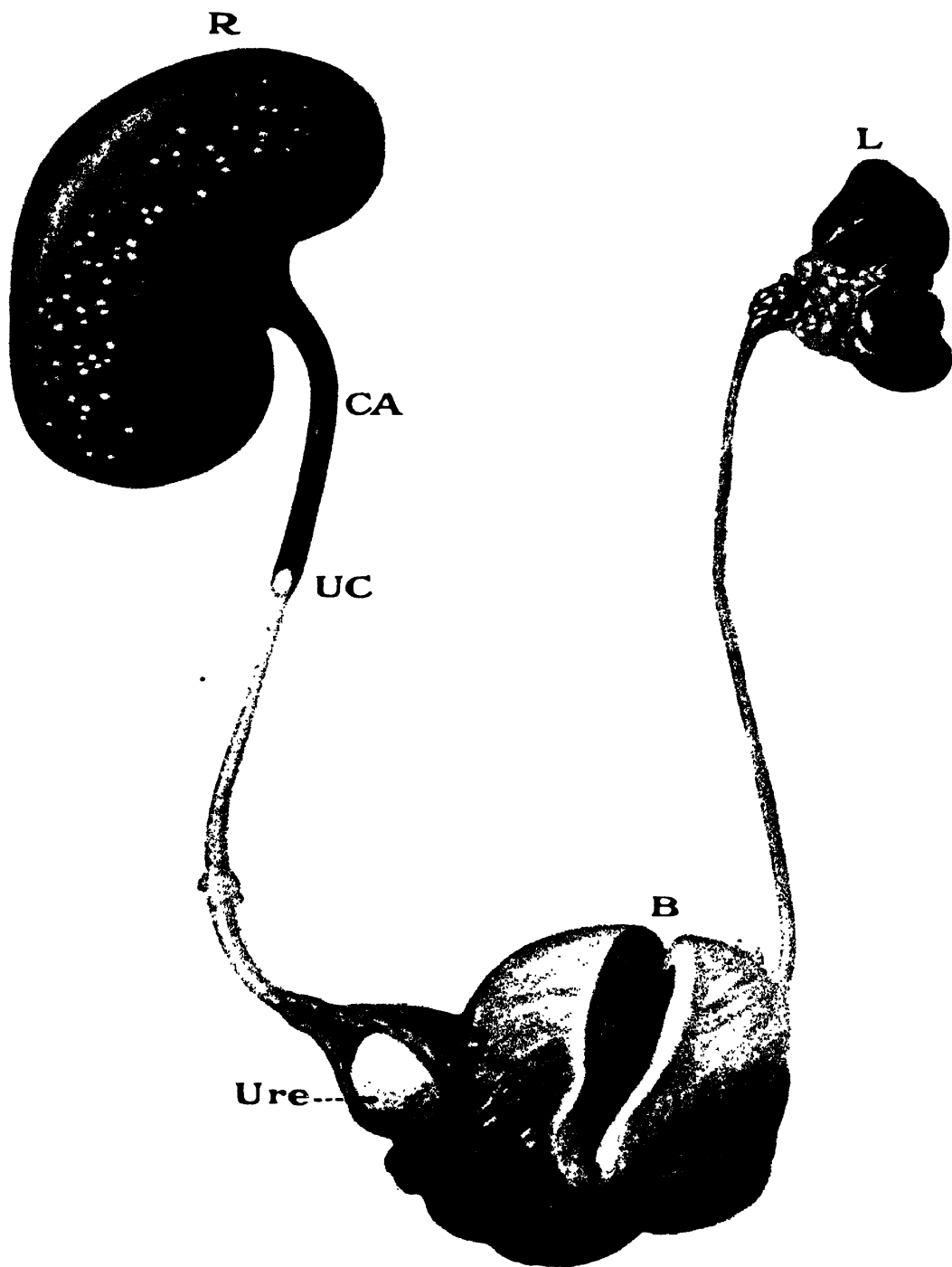
Study of 239 cases of ureteral calculi removed by operative intervention or expelled after catheterization (53 cases). Immediate and complete recovery can be counted on if the patient is capable of bearing general or spinal anesthesia and the operation is not done during anuria. A fistula need not be apprehended if the permeability of the ureter throughout its entire length is determined after extraction of the calculus. The mortality in the cases on record was 1.66 per cent. In examining, after subsidence of the attack of pain, a tender point should be sought along the ureter, above or near the umbilicus, at the intersection of a vertical line passing through McBurney's point and a horizontal line passing through the umbilicus; a second tender point is at the intersection of a line uniting the crests of the ilium and a vertical line through the pubis. The point where the ureter enters the bladder is also liable to be tender. Jeanbrau (*Annales des mal. des org. génito-urin.*, Jan. 15, 1910).

Subjective symptoms of ureteral calculi, when typical, are very characteristic,—renal and ureteral colic,—but are not always present. Not infrequently the only complaint of the patient is a sensation of tension in the region of the calculus. And, finally, there may be no subjective symptoms whatsoever. Palpation gives very uncertain results. If tenderness is elicited upon pressure, it is apt to be restricted and apart from that of other organs—appendix, sigmoid, etc. In addition, chronic appendicitis is not infrequently associated with urinary symptoms. Examination of the urine is of considerable importance in the diagnosis. In every case of ureteral calculus associated with pain there is blood in the urine.

Radiography is the surest method of arriving at a diagnosis of ureteral stone. In some instances, however, the interpretation of the X-ray plate is a difficult matter. This is especially the case in very obese individuals and in cases in which there are phleboliths, calcified glands, or exostoses in the pelvic region. The writer employs a leaded catheter in doubtful cases and is then able to study the relation between the suspected ureteral stone and the course of the ureter as outlined by the catheter. L. Caspar (*Annales des mal. des org. génito-urin.*, Dec. 2, 1911).

The writer reports 10 cases of ureteral obstruction. Two symptoms appear in almost every condition which obstructs a ureter. One is pain between the point of obstruction and the tenth rib on the obstructed side. The pain varies from a dull ache to agony and may produce anything from nervous irritability to vomiting and unconsciousness. It is sometimes increased by motion, as in stone cases; sometimes brought on by a change from the horizontal to the upright position, as in cases with ureteral kink, and sometimes appears without regard to either, as in purulent or bleeding kidneys, when the pain comes and goes quickly with the passage of some fibrin mass through the ureter. Tenderness may or may not correspond in location. When a patient is in pain from ureteral obstruction he is also tender over the affected kidney; when he is not in pain the tenderness may disappear. The other constant symptom is an alteration from the normal habits of urination. We may find increased frequency, urgency, incontinence, or the necessity of repeated attempts before the desire passes away. The presence of any one of these symptoms is a plain warning that something is wrong in the urinary tract. B. Tenney (*Boston Med. and Surg. Jour.*, Mar. 13, 1913).

Calculi in the inferior extremity of the ureter have a characteristic and special symptomatology. They mani-



Specimen Removed at Autopsy, Showing Multiple Calculi in Right Ureter. (*Eisendrath and Herzog.*)

R, greatly enlarged right kidney, showing evidences of suppurative pyelonephritis; *CA*, right ureter distended with blood and urine; *UC*, ureteral calculus located just above a stricture of the ureter; *Ure*, large faceted ureteral calculus located in distended vesical end of ureter; *B*, bladder opened in median line; *L*, undeveloped left kidney, showing fetal lobulations.

fest themselves above all by vesical symptoms, which lead one to think that the patient is suffering from cystitis. The cystoscope, generally, shows a ureteral orifice surrounded by edema. The skiagraph and ureteral catheterization will show with certainty the seat and size of the stone. Pascual (*Jour. d'urol.*, vol. iii, p. 147, 1913).

TREATMENT.—The treatment of calculi passing through the ureter is that already described under renal colic. (See NEPHROLITHIASIS, in the article on KIDNEYS, DISEASES OF, this volume.)

The writer cites a case of stone of the ureter in which he used **sterilized glycerin** to mobilize the otherwise immobile stone. He injected 10 c.c. ($2\frac{1}{2}$ fluidrams) of sterile, warm glycerin into the ureter. This did not destroy the cystoscopic picture. Six hours later the stone was found in the urethra, in the fossa navicularis, from which it was easily removed. Weisz (*Berl. klin. Woch.*, Dec. 4, 1911).

In case of impaction incision into the ureter, ureterotomy, is the only means of relief and cure.

Study of 239 reported cases. The treatment is in the main operative. Removal is indicated at an earlier stage than the removal of renal calculi. In the "interval" their removal has a mortality of 2 per cent. Operation is indicated if the calculus remains impacted for several months, even though the symptoms be mild; if the X-ray picture shows the long axis of the calculus lying transversely to the axis of the ureter; if there are attacks of intermittent hydro- or pyo-nephrosis; if there are symptoms and signs of periureteritis; if urine is absent from the corresponding ureter on cystoscopic examination; if there are any anuric manifestations. Jeanbrau (*Annales des mal. g nito-urin.*, vol. i, Nos. 1 and 2, 1910).

The writer has operated in 61 cases of ureteral calculi. Independent of

these cases there are, up to 1909, 172 cases in the literature. Ureteral calculi most frequently are formed in the kidney pelves. The writer saw but 2 cases of ureteral calculi formed in the ureter. Of the reported cases 64 were in the pelvic portion of the ureter. Of these, 39 per cent. were palpable by rectum or vaginally. Only very large calculi can be felt abdominally. A ureteral catheter may force a small calculus back into the kidney pelvis, or go past the calculus, and enter the kidney pelvis without hindrance. Ureteral calculi give practically the same symptoms as kidney calculi. The radiograph is negative in 11.7 per cent. of cases in which a calculus is present. A bismuth-coated catheter used in connection with radiography often helps in diagnosis. The radiograph should always include the two ureters. The operative indications for ureteral calculi are: Anuria, more than forty-eight hours; bilateral calculi; retention, with or without infection of the kidney, and acute pyelonephritis. In uncomplicated cases operation depends upon the size of the calculus; upon the persistence of the pain in a circumscribed area, and is indicated when the calculus has no tendency to descend. For juxtavesical calculi in women one does a **vaginal ureterotomy**; in men they may be thrust back toward the kidney so as to make the incision and suture of the ureter easier. Often calculi can be worked back into the kidney pelvis and a **pyelotomy** performed. In 53 operations performed by the writer there were but 2 deaths, from myocarditis and cardiac paralysis. Twenty-five cases of uncomplicated **urethrotomies** resulted in no deaths. Israel (*N. Y. Med. Jour.*, from *Folia Urologica*, Aug., 1912).

Case in which 2 large ureteral calculi were removed through the peritoneal cavity. A good recovery was made, the temperature came down at once, and except for washing out the bladder with boric solution there was no trouble with the nursing. To-

gether the stones measured $2\frac{1}{4}$ inches by 1 inch in diameter, and their weight when dry was 226 grains and 91 grains, or a total of 317 grains. Wherry (Brit. Med. Jour., May 17, 1913).

Ureterotomy.—In 1879 T. A. Emmet reported 3 cases in which he had found calculi obstructing the ureter; in one case he removed the stone by forceps after opening the bladder and in another he removed a stone weighing 98 grains by incision through the vaginal wall. Since these operations a considerable number of calculi have been removed from various parts of the ureter. Stones impacted in the vesical portion may sometimes be removed with forceps after suprapubic cystotomy has been performed; in other cases a small incision, with careful dilatation of the orifice, will be necessary. From the lower pelvic portion of the ureter stones have been removed by incision through the vagina and through the rectum, but removal through rectal incision is to be condemned because of the danger of infection.

Stones located higher in the pelvic ureter are removed, preferably after celiotomy, as the extraperitoneal method requires too extensive denudation. Calculi have been removed from the middle portion of the ureter by both retroperitoneal and intraperitoneal ureterotomy; the retroperitoneal method is the method of choice, exposing the ureter in the way described under EXAMINATION OF THE URETERS.

The upper part of the ureter is reached in the same way as the kidney. In some cases in which the stone is lodged high up it may be possible to push it up into the pelvis of the kidney.

STRICTURE AND VALVULAR OBSTRUCTION.—The symptoms of this condition are those due to interference with the free flow of urine. Hydronephrosis accompanied by more or less pain has been present in the cases thus far reported; decomposition of the urine, with irritation of the bladder and frequent micturition, is common.

Treatment.—Kelly has seen great improvement follow **gradual dilatation** by **graduated hollow bougies** in cases of stricture. **Ureterotomy** and **division of the valve** or, in case of stricture, **closing the opening** after the Heinecke-Mikulicz method of suturing the pylorus has been successful in relieving these conditions in a number of cases. **Resection and anastomosis** or **suturing the ureter into** the lower part of the **infundibulum** is sometimes necessary.

The opening of the ureter into the bladder is the narrowest part of its course; it is here that the chief obstacle is presented to free **drainage** in cases of infection of the upper portions of the urinary tract. By means of his **aërocystoscope**, the writer has been able to pass **graduated bougies** in the course of one or several sittings into the ureteral orifice, and to thereby dilate this up to 6.75 mm. in diameter. For the larger sizes he uses chiefly olive-tipped bougies graduated in thirds of a millimeter. In addition to being of use in the treatment of pyoureter and pyelitis, this procedure can be utilized to obtain the passage of a stone *per vias naturales*, the writer employing for this purpose an alligator forceps which he passes for 5 cm. or more up the dilated ureter to grasp a stone which is out of sight, but which has been previously located by X-rays, sound, or wax-tipped bougie. Kelly (Can. Med. Assoc. Jour., vol. i, p. 849, 1911).

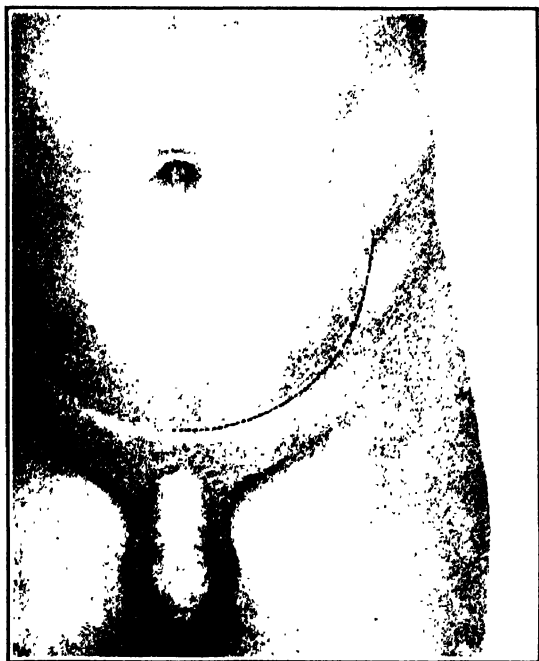


Fig. 1.



Fig. 2.

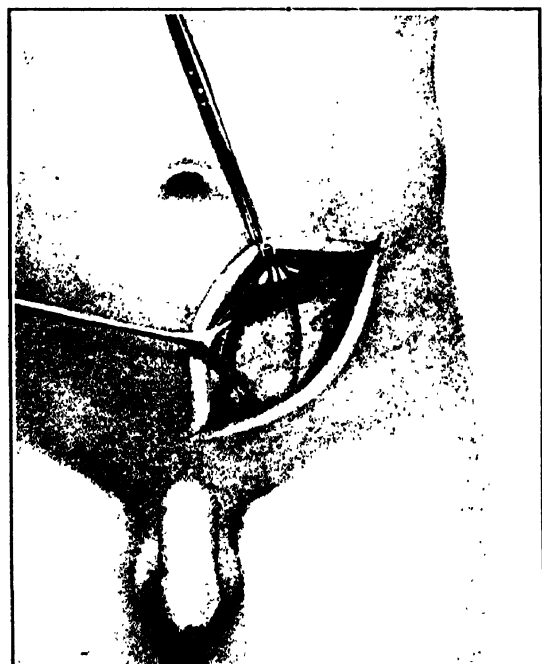


Fig. 3.



Fig. 4.

Technique of Operations on Lower Portion of Ureter. (C. I. Gibson.)

Fig. 1, the superficial incision. Fig. 2, the upper flap consisting of skin, external and internal oblique muscles is retracted. The dotted line represents the line of incision in the transversalis fascia. Fig. 3, the edge of the rectus muscle is strongly retracted inward, between it and the cut edge of the transversalis fascia the peritoneum is exposed. Fig. 4, the peritoneum has been pushed upward. The ureter is lifted out of the pelvis and brought to the level of the external wound.

SURGERY OF THE URETERS.

While obstetric injury to the ureters is becoming less frequent, owing to earlier interference in difficult cases, gynecological injuries are increasing greatly in frequency, because of the increase of extensive operations—especially the radical operation for carcinoma of the uterus—and also due to the fact that many inexperienced operators are now attempting these difficult operations. Stoeckel asserts emphatically that in all cases, except where a malignant growth is present, it is the fault of the operator if the ureter is injured. It matters not in these cases whether the ureters follow a normal course or are displaced by a tumor, or whether the operation is performed by the abdominal or vaginal route, injury to the ureter is always avoidable if proper precautions are taken. Where a malignant growth is present, however, it is a different story. Here it may be necessary to **isolate the ureter** for long distances, to **dig it out** from its carcinomatous bed, to **cut through it**, or to **resect it**.

The ureter and the lower pelvis can be exposed by an incision which the writer has used in over a hundred laparotomies. The skin incision runs from the midline about a finger's breadth above the pubes, horizontally outward nearly parallel to Poupart's ligament at first, and curves rather sharply upward at its midpoint to end about opposite the anterosuperior spine of the ilium. This incision is deepened in the same line through the aponeurosis of the external oblique and the internal oblique muscle; the latter is the only structure which suffers any real damage, and only to a slight degree, for the lower part of the incision runs about parallel to its fibers, only the ascending leg cuts across a small part of these fibers.

The incision stops short of the transversalis, which is not disturbed at all. With efficient retraction of the upper flap the external border of the rectus muscle is identified and the fascia of the transversalis is then divided by a vertical incision close to and parallel to the rectus—that is, at right angles to the original incision. Two retractors are then inserted; the outer one retracts the cut edge of the transversalis outward; the other pulls the rectus muscle well toward the midline.

So ample is the space and view that the whole hand can be introduced under the control of the eye. The ureter is released from its surroundings and easily brought to the external level of the wound. In this way it can be handled readily and freely. The wound is closed without drainage. The transversalis fascia is sutured separately with catgut. Continuous sutures of medium-sized catgut (preferably moderately chromicized) are used for the combined internal and external oblique layer. A few interrupted fine catgut sutures are used for the superficial fatty layer. Very fine continuous silk sutures are used for the skin. Gibson (*Amer. Jour. Med. Sci.*, Jan., 1910).

URETERECTOMY.—The term has been applied not only to the total extirpation of the ureter, but to resections of more than 2 or 3 inches of this organ. The operation is indicated in certain cases of tuberculosis of the ureter, hydrops of the ureter, suppuration in a dilated ureter, and in case of lumbar fistula due to the presence of a diseased ureter after nephrectomy has been performed.

The operation may be primary, when the ureter is removed simultaneously with the kidney, or secondary, when the ureter is removed at a subsequent operation. As nephro-ureterectomy is an extensive operation, usually involving great danger

to life, removal of the ureter is frequently performed at a later operation when the patient's condition has improved. The tendency to formation of dense periureteral adhesions makes it undesirable to defer too long, however. The extraperitoneal method is usually chosen, through the incision described under methods of examination.

Ransohoff (Keen's "Surgery," vol. vi) suggests a method apparently far simpler than any in general use. After division of the ureter near the kidney, a blunt uterine curette is slipped over the end and gradually pushed downward toward the bladder; it separates easily from its bed in this way and when the loop of the curette is advanced as far as possible it is pressed up against the skin, which is buttonholed over it, and the enucleated part of ureter is delivered and removed. The method is not applicable when the ureter is greatly thickened and dilated from obstruction by a large stone, cicatrices, or tuberculosis.

URETEROURETERAL ANASTOMOSIS.—This operation is employed to restore the continuity of the duct after **accidental division** or **division during** abdominal or pelvic operations; after **resection for stricture, ulceration, or sloughing** induced by any condition, particularly calculus, and after **rupture** or **other injuries** due to external violence.

Four methods have been successfully used: direct end-to-end anastomosis; Poggi's end-to-end invagination of the upper into the lower portion of the ureter; oblique end-to-end anastomosis, as practised by Bovée, and lateral implantation, as suggested by Van Hook. Van Hook's method

is most readily and rapidly performed and is generally preferred. Bovée's method might be employed in case there was great loss of substance. In case more than a third of the circumference of the duct is involved by an injury, division and anastomosis would be the preferable method of treatment.

By *Van Hook's method* the lower end of the ureter is ligated and a longitudinal incision twice as long as the diameter of the ureter is made in its wall $\frac{1}{4}$ inch (6 mm.) below the ligature. The upper end is slit up $\frac{1}{4}$ inch (6 mm.) and 2 very small sewing needles threaded on one fine suture of sterilized catgut are passed through its wall from within outward, $\frac{1}{8}$ inch (3 mm.) from its extremity, and $\frac{1}{10}$ inch (1.5 mm.) apart. These needles are carried through the slit in the lower end of the ureter into and down the tube for $\frac{1}{2}$ inch (13 mm.), and are then pushed through its wall side by side. By traction on the catgut loop the upper end of the duct is drawn into the lower portion and the ends of the loop are tied. Although catgut was originally used because its early absorption lessened the danger of the formation of calculus, silk is to be regarded as a safer suture material and no bad results have been reported from its use.

The site of the union is then enveloped in peritoneum, which is stitched in place about it.

The following method of approaching the lower part of the ureter has been employed by the writer in 6 cases. The first patient operated on was a boy 18 years of age with diverticulum of the bladder. A median suprapubic incision was made from the symphysis to the umbilicus, extending through the fascia between the recti

muscles down to the peritoneum. The peritoneum was not opened, but was brushed back from the fundus of the bladder in the usual way, the bladder lifted well forward and opened after the suprapubic space had been packed off with gauze. The bladder was opened in order to explore and pack the diverticulum to facilitate in removing and also to determine if possible the relationship of the diverticulum and ureter so that the ureter would not be injured in removing the pouch. This, however, could not be satisfactorily accomplished from within the bladder, and, with the wall of the left side of the bladder held firmly by an assistant, dissection was carried down to the base of the bladder, exposing and freeing the ureter for 2 or 3 inches. The ureter was held to one side while the diverticulum was separated from the surrounding fatty tissue and removed. The opening in the bladder was closed with the ureter in sight so that it could not be injured or its lumen interfered with. The entire wound healed practically by primary intention and the patient was up and around in ten days and made a complete recovery.

In the second and third cases the operation was performed for stones in the lower ureter. The ureter was exposed as in the preceding case with the diverticulum, except that the bladder was not opened. Besides these two cases of stone in the ureter and the one of diverticulum of the bladder, the method has been used to expose the ureter in 3 cases of extraperitoneal resection of the bladder for cancer. Judd (*Annals of Surg.*, Mar., 1914).

URETERAL IMPLANTATION into the bladder, into some portion of the intestine, and on to the skin have been suggested by many operators and by numerous methods. Such operations are undertaken for the cure of ureteral fistulæ, the prevention of fistulæ in case too great injury has

been done to the ureter to permit of anastomosis, in case of **exstrophy of the bladder**, and for **ureterouterine and ureterovaginal fistulæ**.

In cases of ureterovaginal fistulæ Kelly recommends making a vesicovaginal fistula near by, then inclosing both fistulæ in a circular denudation and suturing the sides together.

Ureterocystotomy.—In this procedure the abdomen is opened and the end of the ureter is freed. An incision is made at a suitable place in the bladder wall; long forceps are introduced into the bladder through the urethra and are used to pull the ureter through the bladder incision, into which it is sutured by fine silk interrupted sutures.

Implantation into the bowel has been performed many times, but infective nephritis has so frequently resulted that the operation is not generally recommended. The sigmoid flexure, or the ascending or descending colon, has been most frequently selected. Fowler (*Amer. Jour. Med. Sci.*, March, 1898, vol. cxv, p. 270) described a method by which he operated successfully on a boy 6 years old for exstrophy of the bladder. After opening the abdomen and isolating the ureters, a longitudinal incision 7 cm. long was made on the anterior wall of the rectum through the serous and muscular coats; the coats were dissected back until a diamond-shaped space on the submucous coat was exposed. A tongue-shaped flap with its base upward was cut in the mucous membrane of the lower half of the diamond. The flap was doubled up, approximating the submucous surfaces, and secured with sutures; thus, a flap-valve was secured, both sides of which were cov-

ered with mucous membrane. The ureters were then placed in the incision with obliquely cut ends, presenting on the external surface of the flap, and were secured by a few stitches in the upper half of the diamond; the flap with the attached ends of the ureters was then pushed into the rectum. The gap in the mucous membrane was closed by cat-gut sutures and then the original wound in the rectal wall was closed by fine-silk sutures. The valve-flap and compression of the circular muscular fibers of the rectum combine to prevent the passage of feces into the ureter during defecation.

In a boy aged 18 who was being operated on for **extroversion of the bladder** the writer transplanted the ureters into the rectum, according to the method advised by Peters. Arumugum (*Amer. Jour. of Surg.*, May, 1911).

The writer reports a successful transplantation of ureter from vagina to fundus of bladder twenty months after **Wertheim operation** in which greater part of trigone was resected. The patient, aged 45, with an extensive carcinoma of the uterus, was very much emaciated, having lost 45 or 50 pounds, and very cachectic. The patient made a good recovery. Gaston Torrance (*Jour. Amer. Med. Assoc.* Oct. 12, 1912).

The writer emphasizes the high mortality of transplantation of the ureters into the intestine, owing to infection. Experimentally he has found that if the ureters are anastomosed instead into the fallopian tubes or the uterus, this drawback is almost entirely obviated. Werelius (*Trans. Amer. Med. Assoc.; N. Y. Med. Jour.*, June 30, 1917).

INJURIES OF THE URETER.—

Aside from the wounds which occasionally occur during surgical operations, injuries of the ureter are ex-

ceptionally rare. Three classes of injuries have been reported: subcutaneous injuries by indirect violence through the unbroken abdominal wall; injuries from penetrating wounds, and wounds inflicted during operations.

Symptoms.—In some cases there is hematuria, which is usually slight and transient. If the rupture has not also torn into the peritoneal cavity, a tumor forms, due to the escape of urine into the areolar tissue. The fluid aspirated from such tumors has the characteristics, more or less pronounced, of urine. As soon as the urine and blood begin to decompose, inflammation and suppuration, with their attendant symptoms, occur. When the injury communicates with the peritoneal cavity, symptoms of peritonitis, which is usually fatal, occur.

Treatment.—The ideal treatment is immediate **suture** or **anastomosis**, but unfortunately the exact injury is not usually recognized until some time has elapsed and the peritoneum has become infected or a retroperitoneal cyst has formed. In case a cyst has formed, **puncture** may be tried, but the result is uncertain. **Lumbar incision**, with **evacuation of the extravasated fluid** and **drainage**, offer the most favorable conditions for repair. Wounds of the ureter usually heal ultimately without suture, although, if the injury be found, it should be repaired. **Nephrectomy** will be required if there is evidence of extensive suppuration, septic nephritis, or a permanent fistula that is a source of intolerable discomfort.

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AND
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KINO.—Kino (resin kino; gum kino) is the inspissated juice of *Pterocarpus marsupium*, a leguminous tree of the East Indies, including southern India and Ceylon. It is obtained from incisions into the trunk, the juice exuding from which is allowed to dry in the sun. It occurs in fragments of a dark-red color (in thin layers ruby-red), without odor, and of a sweetish, strongly astringent taste. It is soluble in alkalies, and usually dissolves to the extent of 80 per cent. in boiling water and in cold alcohol, but is only partially soluble in cold water, and almost insoluble in ether. Its most important constituent is *kinotannic acid* ($C_{18}H_{18}O_8$), of which it contains 40 to 80 per cent. It also includes *kinoin*, a crystalline neutral substance yielding *kino red* on hydrolysis; *gallic acid*, *pyrocatechin*, *pectin*, resin, gum, etc. Upon exposure of a solution of kino to the air the insoluble, amorphous substance *kino red* is deposited.

PREPARATIONS AND DOSE.—*Kino*, U. S. P. (kino). Dose, 5 to 30 grains (0.3 to 2 Gm.); average, $7\frac{1}{2}$ grains (0.5 Gm.).

Tinctura kino, U. S. P. (tincture of kino), made from 5 parts by weight of kino, 1 part of purified tale, 15 parts by volume of glycerin, 65 parts of alcohol, and water, enough to make 100 parts. Tends to gelatinize unless carefully prepared and kept in small, well-stoppered bottles. Dose, $\frac{1}{2}$ to 2 fluidrams (2 to 8 c.c.).

Tinctura kino et opii composita, N. F. (compound tincture of kino and opium), every fluidram (4 c.c.) of which represents $\frac{1}{2}$ grain (0.03 Gm.) each of kino and opium. Dose, 1 fluidram (4 c.c.).

Pulvis kino et opii compositus, N. F. (compound kino powder), consisting of a mixture of 15 parts of powdered kino with 4 of cinnamon and 1 of powdered opium. Dose, 15 grains (1 Gm.).

PHYSIOLOGICAL ACTION.—The physiological action of kino may be said to be that of its main constituents, kinotannic and gallic acids, especially the former. It is an astringent and styptic, exerting its activity in these particulars throughout the length of the intestinal tract. Its value in arresting intestinal hemorrhage is thus explained.

THERAPEUTICS.—Kino is a mild astringent. It is useful in *sercus diarrhea*,

for which purpose it is generally combined with paregoric and chalk mixture, or exhibited in the form of the compound powder of kino, of which 5 to 20 grains (0.3 to 1.25 Gm.) are given at a dose. Kino is a serviceable remedy in *pyrosis*.

Locally and internally kino possesses some value as an hemostatic in passive **hemorrhage from the intestines** and other viscera. The tincture may be used as an astringent gargle in **pharyngitis** or for **relaxation of the uvula**. It is a not infrequent ingredient of injections in **gonorrhea** and **leucorrhea**. The powder may be applied as a stimulating astringent dressing to **chronic ulcers**. In relaxed conditions of the mouth and throat and in **epistaxis** the tincture may be used with benefit. S.

KNOCK-KNEE. See ORTHOPEDIC SURGERY.

KOLA (Soudan coffee; Bichy nuts; cola; Guru or Gooroo nuts) consists of the recent or dried cotyledons of *Cola vera* Schum, or of *Cola acuminata* (Schott), from tropical Africa and the West Indies. When fresh the nuts are either white or purplish red. The natives use the fresh kernels, usually after these have been caused to germinate, because they are then sweeter. The color changes on keeping to a dull purplish brown. When thoroughly dried these nuts keep well indefinitely. Kola seeds contain fat, 0.1 per cent. of volatile oil, from a trace to 4 per cent. of sugar, more than 40 per cent. of starch, 1.7 to 4 per cent. of kola tannin, and 1.5 to 3.6 per cent. of total alkaloids, of which $\frac{1}{100}$ to $\frac{1}{10}$ is theobromine ($C_7H_8N_4O_2$), and the rest is caffeine ($C_8H_{10}N_4O_2$). The caffeine percentage in kola increases on drying.

PREPARATION AND DOSE.—The crude drug is not official:—

Cola. Dose, 20 to 40 grains (1.3 to 2.6 Gm.).

Semiofficial is the following preparation: *Fluidextractum sterculia*, N. F. (fluidextract of sterculia). Dose, 15 minims (1 c.c.).

THERAPEUTICS.—Kola is employed for the same purposes as caffeine. It has been recommended for the treatment of **cardiac failure**, **tropical diarrhea**, **head-**

ache, neuralgia, migraine, and in nervous breakdown from overwork. It has been claimed that the nut when eaten increases the power to endure fatigue without food. In **asthenia** the drug sometimes affords immediate and permanent relief, especially if the condition is of nervous origin. Kola is a decided diuretic, more prompt and efficacious than digitalis and caffeine in combination (Tarbrough). It affects the kidney directly and, in addition, raises the blood-pressure. Kola is further used in **melancholia**, in **chronic alcoholism**, and in **morphinism** as a stimulant and against the shock of the withdrawal of the accustomed drug. It is of service also in **insomnia** from fatigue and exhaustion.

W.

KOUMISS AND KEFIR.—Koumiss (kumiss; kumyss; lac fermentatum) consists of milk which has been altered by both lactic acid and alcoholic fermentation, the latter process taking place through the agency of yeast. Kefir (kephir; kapir; kephir-kumyss) is milk—originally mare's milk—subjected to fermentation by *Streptococcus kefir*, an organized ferment occurring in large granules; as in the case of koumiss, lactic acid fermentation takes place simultaneously. In this country kefir is usually made with the so-called "kefilac" tablets.

PREPARATION.—**Koumiss:** Fresh cows' milk, 1000 c.c.; semiliquid yeast, 5 c.c.; sugar, 35 Gm. Dissolve the sugar in the milk, contained in a strong bottle; add the yeast, cork the bottle securely, and keep it at a temperature between 73.4° and 89.6° F. (23° and 32° C.) for six hours; then transfer to a cold place (National Formulary).

A formula by G. Carroll Smith for home-made koumiss is the following: Boil fresh milk, and when nearly cold put into quart bottles, leaving room enough to shake. Add ½ ounce of granulated sugar and a piece of Vienna yeast the size of a hazelnut; cork with new corks, tie down, keep cool, lay the bottles horizontally, but shake twice daily. The preparation is ready for drinking on the sixth day, or earlier in hot, later in cold, weather. The koumiss can be made thinner by using skimmed milk.

Instead of preparing koumiss with

sweet milk, and waiting for it to turn sour, 1 part of ready-made koumiss may be added to 2 parts of fresh milk, the casein being thus precipitated at once. Although in this case yeast is not necessary, sugar must be added to produce sufficient carbonic acid gas to make it effervescent.

Koumiss may be made from sour milk, freed from its cream, by breaking up the curd by strong stirring, and adding the sugar and yeast.

Kefir may be prepared by adding active kefir grains or 1 kefilac tablet to 1 pint (½ liter) of fresh cows' milk and keeping it at a temperature of 70° to 80° F., until the grains rise to the surface or, in case the kefilac tablet has been used, forty-eight hours.

The grains may then be strained off for further use. The milk will retain sufficient yeast-cells to cause it to ferment if put aside in well-stoppered bottles. The bottle should be shaken 4 or 5 times a day until ready for use, and thereafter whenever part of the contents is to be poured off.

THERAPEUTICS.—Koumiss and kefir provide most of the elements of milk in an agreeable, readily digestible form, and are of distinct value in cases where milk is not well borne or for some other reason cannot be taken. They differ in composition from cows' milk in containing only about 1.5 per cent. of milk-sugar, and in including 2 per cent. of alcohol and nearly 1 per cent. of lactic acid. The casein is present in so finely divided a state that it cannot form lumps in the stomach and is thus readily digested by the gastric juice.

Both koumiss and kefir, when ingested, tend to increase the appetite, cause an agreeable sensation of warmth in the stomach, and augment the desire for fluid intake. Constipation is overcome, and either the renal or the sweat function is increased, according to the prevailing air temperature. Deposition of fat in the organism is favored. Slight drowsiness may be noted. Where diarrhea is produced, lime water may be added to either preparation.

Therapeutic use of koumiss and kefir was first made in **pulmonary tuberculosis**. In the Russian koumiss cure the koumiss

is given at short intervals during the day—but not for two hours previous to heavy meals—and in ascending amounts.

In quantities of from 1 pint to 2 quarts ($\frac{1}{2}$ to 2 liters) they have been of good service in gastric disorders, such as **cardialgia**, **catarrh**, **atony**, **dilatation**, **vomiting**, **digestive disturbances**, and **gastric ulcer**. In **hypochlorhydria** the use of kefir increases the hydrochloric acid. Cases of severe **diarrhea** are benefited by kefir. Its main indication is in **autointoxication** due to the intestinal putrefaction of protein substances. Kefir is contraindicated in hyperpepsia with retarded emptying of the stomach and with excessive secretion, as well as in pyloric stenosis. In general, it should not be used in gastric ulcer, though in chronic cases with slight secretion it may be of great value.

A point of special interest is the possibility of adding various drugs to kefir during or after its preparation, *e.g.*, lactate of iron, arsenic, iodides, creosote, and guaiacol. Substances which do not inhibit fermentation may be added when the ingredients of the kefir are first mixed; creosote and guaiacol are best added to the finished product.

W. and S.

KOUSSO. See Cusso.

KRAMERIA.—*Krameria* (rhatany), named after J. G. H. Kramer, a Hungarian physician and botanist (Tschirch), is the dried root of *Krameria triandra* (Peruvian krameria), of *K. ixina* (Savanilla krameria), or *K. argentea* (Para or Brazilian krameria), small shrubs of the family Leguminosæ. The Peruvian variety of krameria is also obtained from Bolivia, and the Savanilla krameria from Colombia, British Guiana, and Brazil. The bark of the root is strongly astringent in taste, but almost devoid of odor. The woody part is inodorous and tasteless, and is relatively inactive. The smaller roots are therefore preferred. *Krameria* contains 8 to 20 per cent. of **kramerotannic acid** (the active ingredient), gum, starch, sugar, and a peculiar acid called **krameric acid**. *Krameria*, in common with kino, is an ingredient of the **pulvis catechu compositus** (B. P.).

PREPARATIONS AND DOSE.—*Krameria*, N. F. (*krameria*; *rhatany*). Dose,

5 to 30 grains (0.3 to 2 Gm.); average, 15 grains (1 Gm.).

Extractum krameria, N. F. (extract of krameria). Dose, 5 to 20 grains (0.3 to 1.25 Gm.); average, $7\frac{1}{2}$ grains (0.5 Gm.).

Fluidextractum krameria, N. F. (fluid-extract of krameria). Dose, 5 to 30 minims (0.3 to 2 c.c.); average, 15 minims (1 c.c.).

Tinctura krameria, N. F. (tincture of krameria), a 20 per cent. preparation. Dose, $\frac{1}{2}$ to 2 fluidrams (2 to 8 c.c.).

Syrupus krameria, N. F. (syrup of krameria), made by mixing 9 parts of fluid-extract of krameria with 11 parts of syrup. Dose, 20 to 90 minims (1.25 to 6 c.c.); average (U. S. P.), 1 fluidram (4 c.c.).

Trochisci krameria, U. S. P. VIII (troches or lozenges of krameria), made by mixing together 6 parts of powdered extract of krameria, 65 parts of sugar, and 2 parts of tragacanth, forming a mass with stronger orange-flower water, and dividing into troches. Each lozenge contains 1 grain (0.6 Gm.) of krameria.

Tincture of *Savanilla rhatany* forms a clear solution, tincture of Peruvian rhatany a cloudy mixture, with water (Kraemer).

PHYSIOLOGICAL ACTION.—The kramerotannic acid imparts to krameria its astringent properties. The drug seems to act particularly well upon the mucous membranes, and its beneficial influence in all conditions characterized by relaxation of the latter is pronounced. It is better borne when taken internally than tannic acid.

THERAPEUTICS.—*Krameria* is used largely as a remedy for bowel disorders, viz., in **chronic diarrhea**, in **dysentery**, and in passive **hemorrhage from the intestines** and other viscera. A 5 to 10 per cent. aqueous solution of the fluidextract for daily irrigation of the lower bowel in **colitis** is useful. Swan recommends the following in chronic diarrhea:—

R. Acidi sulphurici aro-

matici f3ss (15 c.c.).

Tr. opii camphorata ... f3j (30 c.c.).

Extracti hamatoxyli ... 3ss (15 Gm.).

Syrupi krameria f3iiss (45 c.c.).

Aque cinnamomi q. s. ad f3vj (200 c.c.).

M. Sig.: Two teaspoonfuls in water every three hours.

In **leucorrhœa** and **gonorrhœa** the astringent action of **krameria** may be availed of. **Chronic pharyngitis** and inflammatory conditions of the respiratory mucosæ are generally benefited, though tannic acid is more convenient to use and effective. **Spongy gums** and **anal fissure** are among the numerous local conditions in which

krameria has proven useful. The drug may be employed in a 10 per cent. ointment or, in **hemorrhoids**, in a suppository containing 15 grains (1 Gm.) of **krameria**, with or without cocaine, epinephrin, etc. S.

KRAUROSIS VULVAE. See VAGINA AND VULVA, DISEASES OF.

L

LACHRYMAL APPARATUS, DISEASES OF.

SECRETORY APPARATUS, DISEASES OF THE.

DACRYOADENITIS.

Inflammation of the lachrymal gland is of rare occurrence, either in the acute or chronic form. It is indicated by swelling and edema of the upper lid, and pain and tenderness on pressure of the gland and the adjacent supraorbital margin. The disease may assume a purulent form, when an abscess may open, either upon the conjunctiva or through the skin.

Rheumatism, cold, syphilis, septicemia, and mumps have all been ascribed as the cause in various cases, while the spread of inflammation from the conjunctiva and cornea has been noted in a number of instances.

Treatment.—Hot applications and poultices in the early stages, followed by free incision under the supra-orbital region as soon as pus has formed. In the chronic variety the local application of absorptive ointments, such as the **mercurial** and the **compound iodine ointments**, should be employed, while **potassium iodide**, **mercury**, and the **salicylates** should be administered internally. In acute cases an active **calomel purge** should be prescribed, followed by large doses of **quinine**.

TUMORS, such as sarcoma and adenoma, and hypertrophy of the gland are of rare occurrence. The latter is at times of congenital origin, but is usually an affection of later years. The gland may attain a large size, and cause serious damage to the eyeball by compression.

Treatment.—**Extirpation** of the gland is indicated in cases of neoplasms and extreme hypertrophy, or where there is obstinate stillicidium which cannot be controlled in any other way. This is accomplished by removing the gland, either directly through a skin incision made over the gland, or by an incision through the conjunctiva after exposure of the *cul-de-sac*, by division of the external canthus. The latter procedure is the one usually employed, as the ptosis which is apt to follow the first mentioned, due to injury of the levator, is avoided, and the resultant scar is much less conspicuous.

ATROPHY of the lachrymal gland is very rare, being usually associated with xeroma of the conjunctiva.

DACRYOPS is the name given to a cystic disturbance of one of the ducts of the gland, and occurs as a bluish-pink, translucent, elastic tissue, which is found under the conjunctiva in the region occupied by the gland.

LACHRYMAL FISTULA may form occasionally as a sequel of inflammation or traumatism of the gland, and may cause a constant discharge of tears through its orifice. A similar condition has also been observed of congenital origin.

DISLOCATION OF THE LACHRYMAL GLAND has been met with in a few instances as a result of trauma, and in a very few in which the prolapse was congenital. In other rare instances it was spontaneous in origin.

EXCRETORY APPARATUS, DISEASES OF THE.

In contradistinction to diseases of the secretory portion of the lachrymal apparatus, diseases of the excretory portion are of very frequent occurrence and are all characterized by the common and annoying symptom of tears flowing over the cheek.

ANOMALIES OF THE PUNCTA LACHRYMALIA AND OF THE CANALICULI.

Congenital.—Complete obliteration or absence of the puncta as well as double puncta has been occasionally observed. At times the puncta and canaliculi may be wanting, the canals being represented by narrow grooves along the edges of the lid.

Acquired.—Such anomalies are usually the result of chronic inflammations of the lids and conjunctiva which have disturbed the normal relationship existing between the puncta and the bulbar conjunctiva. They are frequently induced by old age, due to a senile relaxation in the orbicularis palpebrarum, and are constantly present in paralysis of the seventh nerve.

Eversion of the punctum is almost

a constant consequence of ectropion, and is also present in those rare cases when the eyeball is so deeply set that a triangular space intervenes between the lid and the globe.

Complete obliteration is a not infrequent result of burns and traumatisms which have involved the lids, and of granular conjunctivitis and blepharitis. Rarely, the canal may be blocked by a cilium or polypus, or by leptothrinx.

Symptoms.—The most common symptom of all these anomalies is the constant overflow of tears. This is annoying in itself, but, more than that, it frequently causes such irritation of the skin about the lids that an inflammation is set up which causes contraction of the parts, and still further interference with the proper canalization of the tears.

Hyperemia and catarrh of the conjunctiva are constantly present, consecutive to all forms of lachrymal obstructions.

Treatment.—Usually the simple dilatation of the punctum, or the slitting up of the canaliculus, is sufficient to effect a cure; with the co-operation of an astringent wash of zinc and boric acid.

If the condition has been brought about, however, by a high degree of ectropion, or is the result of an extensive burn, relief will be frequently difficult to attain, and extensive plastic operations may be necessitated before the lid is restored to its normal position.

ANOMALIES OF THE LACHRYMAL SAC AND NASAL DUCT.

DACRYOCYSTITIS, or inflammation of the lachrymal sac, may be either acute or chronic.

Symptoms.—The disease is rarely acute, but begins generally as a chronic inflammation, which manifests itself by a slight swelling and redness at the inner canthus, and by persistent and troublesome lachrymation, or by the discharge of a mucopurulent secretion from the inner canthus of the eye. Pressure on the sac will express a secretion which is either mucoid or mucopurulent, either into the conjunctival *cul-de-sac* or into the nose. This condition of affairs may persist and the sac may become chronically disturbed, and give rise to a tumor of considerable size (lachrymal tumor, or mucocoele). Frequently the inflammation assumes an acute form, and the region of the sac becomes swelled and reddened and a thick, creamy pus forms in the sac, which is only expressed after some difficulty. The pain is intense, and there are marked constitutional symptoms, such as fever and loss of appetite. If the parts are undisturbed, the skin ulcerates and is perforated, usually beneath the tendon of the orbicularis muscle, and a permanent fistula is formed. More rarely, the opening in the sac heals, and the formation of the fistula is avoided. As a result of the fistulous formation, pus frequently burrows into the deeper tissue, and necrosis of the neighboring bones is not rarely occasioned.

Etiology.—In the great majority of cases dacryocystitis is secondary to diseases of the lachrymonasal duct, primary inflammation of the lachrymal sac being an extremely rare affection. It is a disease of adults, being rare in children, when it occurs under 10 years of age being usually significant of inherited syphilis.

Treatment.—As inflammation of the lachrymal sac is dependent in most cases upon disease of the lachrymal duct, any obstruction existing there should be combated in the manner presently to be described. If this has been neglected, however, and an acute exacerbation has been inaugurated, **hot applications** should be made to the tumor, and any **pus evacuated** by **incision** into the sac through the dilated lower canaliculus as soon as its presence is manifested. A lead style should then be inserted into the duct and allowed to remain *in situ* for several months until the patulency of the canal is restored. **Calomel** and **quinine** should be administered internally.

STRICTURE OF THE LACHRYMAL DUCT.

SYMPTOMS.—These are the same as in the first stages of dacryocystitis, and consist chiefly in obstinate lachrymation and in the ability to express a viscid matter into the *cul-de-sac* by pressure with the finger upon the lachrymal sac.

Stricture of the lachrymal duct is favored greatly by its relationships and by the anatomy of its parts. The mucous membrane which lines the bony walls of the canal is very vascular, and at certain parts is thrown into folds, which swell under slight provocation and offer sufficient obstacle in themselves to prevent the proper canalization of the tears. Again, the duct bears such a close relationship to the nose that it is necessarily exposed to all inflammations of this cavity. Indeed, the great majority of cases of lachrymal obstruction are secondary to acute or chronic disease of the nose. This is

particularly true of nasal disease of syphilitic origin. As a consequence of its liability to inflammation by direct continuity of structure, the nasal end of the duct is the most frequent seat of stricture, the commencement of the duct at the extremity of the lachrymal sac offering the next most favorable site for the development of stricture.

TREATMENT.—While an absolute and a complete cure of lachrymal obstruction may be frequently attained, more often relief is only partial.

Treatment may be either palliative or curative. The former consists in repeatedly **pressing the contents of the lachrymal sac into the nose** by the finger, and by the employment of **antiseptic and astringent eye-washes**, or by throwing a stream of **boric acid solution** into the sac by means of an Anel syringe. Attention must be directed toward the nasal mucous membrane, and any local irritation existing about the nasal opening of the duct must be controlled with local applications.

The curative plan of treatment resolves itself into some form of **surgical procedure**. These measures have been conveniently classed by Theobald under four heads: 1. Those which aim to restore the natural passages. 2. Those which have for their object the formation of a new passage into the nose for the tears. 3. Those which aim at the obliteration of the natural passages,—the lachrymal sac and duct. 4. The removal of the lachrymal gland for the purpose of arresting the secretion of tears.

The first step toward the restoration of the natural passages consists in the **operation of Bowman**, which

consists in **slitting up the lower canaliculus throughout its entire length**. This is accomplished by entering a fine canaliculus knife into the inferior punctum, and by slowly pushing it along the floor of the canaliculus until it abuts against the inner wall of the sac, as it rests against the lachrymal bone. The handle of the knife should now be swept upward, while an upward and slightly backward inclination is given to the blade of the knife.

A ready and free entrance into the sac being gained by the successful accomplishment of this act, attempts should be made to engage the stricture, and to **dilate** its caliber by means of **probes**. I generally first make the attempt with a very small Bowman probe, and then gradually increase the size by passing slightly higher numbers every second or third day. I am satisfied after a No. 8 probe can be passed into the nose without difficulty. Larger probes are not employed, as they are apt to injure the mucous membrane and periosteum, and in some cases to lead to necrosis. Weber, Cooper, and Theobald, however, think sounds of the size of a Bowman No. 8 quite inadequate, and have devised probes of much larger caliber, employing instruments of a diameter of 4 mm. in the treatment of the majority of their cases. As stated above, I am generally satisfied with a moderate dilatation, and alternate the passage of probes with careful **syringing of the duct with a weak solution of zinc and boric acid**.

In infants operative procedure should be postponed until palliative measures have been thoroughly tried, although in obstinate cases this may

be successfully accomplished under a general anesthetic.

To prevent closure of the duct after it has been made patulous, a number of operators insert a **lead** **style**, leaving this in position for several weeks or months. This is of especial value when the patients live at a distance, and cannot submit to the frequent and continued probing which is necessary to attain the best results.

Other surgeons prefer **rapid dilatation**, and insert probes of the largest size into the duct at the first sitting, this being usually performed under ether.

Should the lachrymation still persist after probing has been given a thorough trial, I resort to leaden styles, permitting them to remain *in situ* for months and even years. Care should be taken that the head of the style rests securely in the groove of the slit-up lower canaliculus to insure the patulency of that structure. The insertion of the style into the duct is greatly facilitated by the use of the **Ziegler style inserter**.

In intractable cases—as, for example, when the stricture is bony—two procedures have been practised: the **removal** of the lachrymal gland and the **obliteration** of the lachrymal sac. The former of these has been modified by de Wecker, who excises the little lobules and the emissary ducts from both the subsidiary and main lachrymal glands.

Extirpation of the sac should be resorted to in all cases of long-standing lachrymal disease where the mucous membrane has become chronically inflamed and continued local astringent treatment, with probing, has been unavailing. The procedure also is indicated in lachrymal mucocele, in

fistulæ, and in all suppurative conditions. If performed with extreme care after the method described by Meller, of Vienna, scarring is slight and the resultant epiphora of but little annoyance.

Toti has recently devised an **operation** which aims to relieve the symptoms produced by stricture of the lachrymal duct by establishing a connection between the sac and the roof of the nose, by means of a resection of the lachrymal bone and excision of a portion of the external wall of the sac. The procedure, however, has failed to commend itself but to a few, and has not been generally practised.

WILLIAM CAMPBELL POSEY,
Philadelphia.

LACTATIONAL INSANITY.

See PSYCHOSES.

LACTIC ACID (*acidum lacticum*, U. S. P.), official lactic acid ($\text{HC}_3\text{H}_5\text{O}_3$), is a colorless, odorless, syrupy liquid, having a very sour taste and a specific gravity of 1.213 at 59° F. (15° C.). It is hygroscopic, and is miscible in all proportions with water, alcohol, and ether, but is insoluble in chloroform, carbon disulphide, and benzin.

PREPARATION AND DOSE.—*Acidum lacticum*, U. S. P. (lactic acid), contains 75 per cent. of absolute lactic acid. Dose, 15 to 30 minims (1 to 2 c.c.).

PHYSIOLOGICAL ACTION.—Lactic acid is present in the stomach during the digestion of carbohydrates, especially during the first stage of gastric digestion, when, in excess, it forms one variety of sour stomach and causes pain in different parts of the body, headache, etc. Rheumatoid symptoms sometimes develop after the drinking of sour milk. Large amounts depress the nervous system and decrease the alkalinity of the blood.

THERAPEUTICS.—Lactic acid is a caustic, astringent, digestive, and anti-diabetic remedy. It is used, diluted, in **dyspepsia**, **diarrhea**, **croup**, **cholera**; in pure form, as a solvent of false mem-

branes; in **tuberculous affections of the mouth, esophagus, and larynx**; in **lupus**, and in **alopecia**. Sherman and Lohmes (Med. Rec., Aug. 28, 1920) describe lactic acid as a therapeutic food.

LACTUCARIUM.—Lactucarium ("lettuce opium") is the concrete milk-juice of *Lactuca virosa*, family Compositæ, a wild variety of lettuce growing in Europe. It is obtained by cutting off the summits of the plant stalks, collecting the latex when it has partially hardened, and further drying in earthen cups. It occurs in irregular, brown lumps, which are wax-like internally when cut, somewhat porous, and possess an opium-like odor and a bitter taste. It is partly soluble in alcohol and in ether, and about 50 per cent. of it will dissolve in water. Lactucarium contains 50 per cent. of *lactucerin* (a white, crystalline, odorless, and tasteless principle, soluble in alcohol); *lactucin* (a bitter principle in fine, white prisms, soluble in alcohol and in 80 parts of water); *lactucic acid* (very bitter, yellow, and colored red by alkalis); *lactucopierin* (very bitter, brown, and amorphous); a volatile oil, mannitol, citric, malic, and oxalic acids, etc. Hyoscyamine is also said to have been found in lactucarium.

PREPARATIONS AND DOSE.—*Lactucarium*, U. S. P. (lactucarium). Dose, 5 to 60 grains (0.3 to 4 Gm.); average, 15 grains (1 Gm.).

Syrupus lactucarii, U. S. P. (syrup of lactucarium), contains 10 per cent. of tincture of lactucarium, 20 per cent. of glycerin, 5 per cent. of orange-flower water, and 0.1 per cent. of citric acid. Dose, $\frac{1}{2}$ to 2 fluidrams (2 to 8 c.c.); average, 1 fluidram (4 c.c.).

Tinctura lactucarii, U. S. P. (tincture of lactucarium), contains the equivalent of 50 per cent. of lactucarium, together with glycerin, alcohol, purified benzin, and water. Dose, 10 to 60 minims (0.6 to 4 c.c.); average, 30 minims (2 c.c.).

PHYSIOLOGICAL ACTION.—Lactucarium has been credited with hypnotic properties, but recent experience with it has shown that this action is very feeble, if, indeed, it is produced at all. Experimentally the drug has proven inactive, half an ounce having been given to a dog without result (Cushny).

THERAPEUTICS.—Lactucarium is chiefly used in slight irritation of the **larynx**, to allay **nervous irritability**, and in cases where there is an idiosyncrasy against opium. The syrup may be used in **cough** mixtures for children and delicate subjects. Also for general sedative purposes in children, the syrup may be used as vehicle for and adjuvant to bromides, orange-flower or cherry-laurel water being added as flavor. Lactucarium lozenges for **cough** are on the market. At least one of the proprietary lozenges has been found to contain opium. Lactucin may be tried as an hypnotic and sedative in the dose of 1 to 2 grains (0.06 to 0.12 Gm.). S.

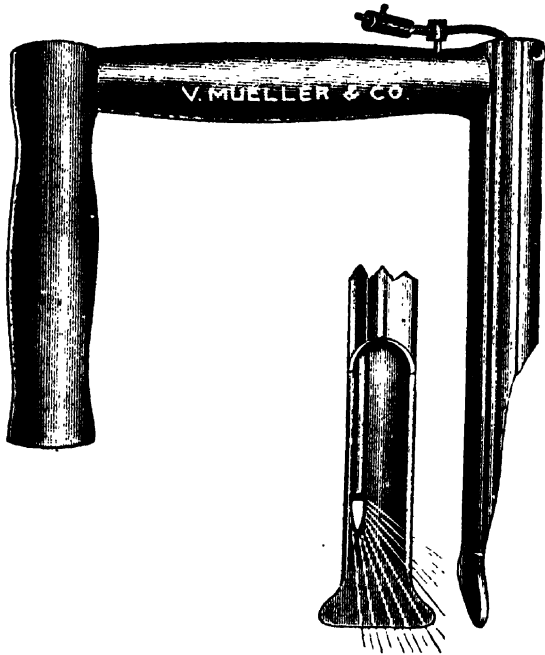
LARYNGITIS. See LARYNX.

LARYNGOSCOPY, BRONCHOSCOPY, AND ESOPHAGOSCOPY.—Kussmaul in 1868 and Mikulicz in 1881 were the first to take up the subject of esophagoscopy and gastroscopy. Kerstein in 1895 first developed, and Killian in 1896 perfected, the procedure of laryngo-tracheobronchoscopy. Since then the direct method for the removal of foreign bodies has superseded all other means, and has, more recently, been employed for the purpose of diagnosing pathological conditions of the esophagus, stomach, and laryngo-tracheobronchial system. Later still, it came into use for the treatment of many conditions formerly dealt with by internal medication only, *e.g.*, asthma and bronchiectasis.

It is now possible, however, by the use of Chevalier Jackson's laryngeal speculum, to examine and diagnose conditions of the larynx in even the very youngest infant—an accomplishment impossible by the old, indirect method of using the laryngeal mirror. Endoscopy has thus not only broadened the field of the specialist, but has also been the

means of making extensive contributions to general medicine.

It is to Killian first, and later to Brünings in Germany, Guisez in France, and Jackson in America, that



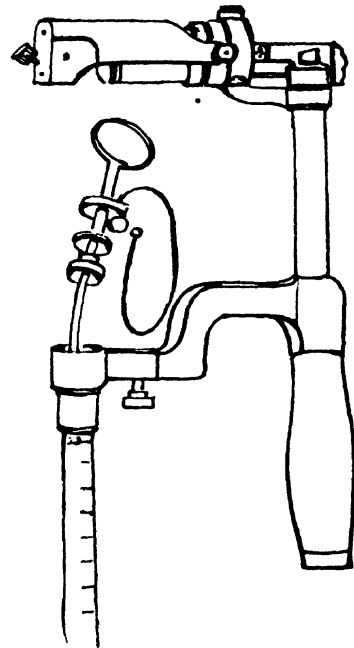
Jackson's laryngeal speculum with removable slide.

we are most indebted for our present knowledge in regard to bronchoscopy and esophagoscopy. The endoscopic instruments for the examination of the bronchi and the esophagus are practically of two kinds. In one the light is at the distal end and inside the tube, as in Jackson's instruments. In the other the light is at the proximal end and outside the tube, as in Brünings's bronchoelectroscope or Kahler's modification of that instrument.

LARYNGOSCOPY.—This term was formerly limited to the indirect examination of the larynx by the laryngoscopic mirror. The use of the latter is so familiar to all physicians that it is not deemed necessary to devote space to it in the present article, the purpose of which is to review the more modern methods of inspection.

The writer has his mirrors made with a space at the back which can be filled with a mixture of sodium acetate and pulverized glass or paraffin, heated to melting point. As the chemical hardens it emits warmth for several minutes, and as the mirror is thus kept warm no droplets of moisture accumulate on it. The mirrors are made a little larger and heavier by this contrivance, but not enough to interfere with the use of the laryngoscope. Louwer (*Deut. med. Woch.*, Jan. 30, 1908).

The writer applies an epiglottic suture in direct laryngoscopy, using improved instruments for the procedure. Cocainizing of the region is the only preliminary. The procedure is simple, without any ill effects, while it affords a greatly increased



Brünings's bronchoelectroscope, with lamps in the high position and forceps introduced. (Brünings and Howarth's "Bronchoscopy.")

field of vision and is a great aid in many throat operations. It is useful in any case in which the epiglottis hinders a delicate intralaryngeal manipulation or operation. Cyril Horsford (*Brit. Med. Jour.*, May 3, 1913).

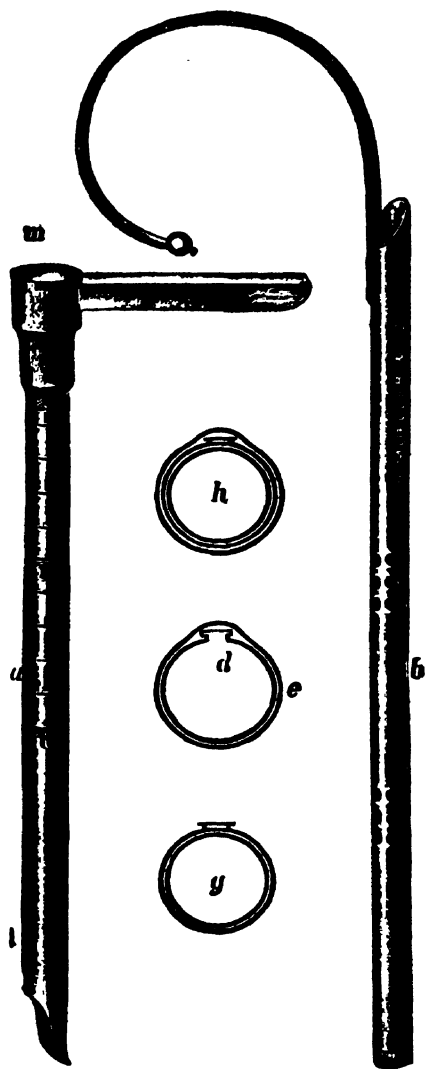
Endoscopy. — Chevalier Jackson's endoscope is a separable laryngeal speculum which serves for the direct examination of the larynx and hypopharynx, for passing the catheter in intratracheal anesthesia, for passing the bronchoscope, and also for the endoscopic examination of the esophagus and stomach. Brünings's endoscopic instruments comprise the electroscope and the laryngeal speculum, through which can be passed the extension tube with a spiral watch-spring for endoscopy of the bronchi and esophagus. The source of light may be either sets of lights furnished by dry-cell batteries or an electric current controlled by a rheostat, which so reduces its strength as to make it merely sufficient to light the lamp. Meyrowitz has now on the market a rheostat that prevents any danger of electric shock to the patient from grounding of the current through his body. In Jackson's instrument the current is usually supplied by his set of dry-cell batteries—one for the laryngeal speculum and one for the tubes—controlled by rheostats.

The position for endoscopic work in the adult may be either the upright posture or the dorsal decubitus; for infants the dorsal decubitus is far preferable. Either cocaine or ether anesthesia may be employed for adults; for young children and infants cocaine anesthesia should never be used.

Anesthesia for endoscopy is subject to the following rules:—

For foreign bodies, no anesthesia is needed in either adults or children, except in case of very large and sharp foreign bodies, wherein the relaxation of the esophageal musculature, by deep general anesthesia,

will obviate the trauma incident to the withdrawal of the intruder through a spasmodically constricted lumen.



Extensible double tube of Brunings's bronchoelectroscope. (*Brunings and Howarth.*)

In case of a sharp foreign body threatening perforation, especially open safety-pins and fishhooks, it is safer to abolish antiperistalsis by deep general anesthesia.

In cases of suspected esophagismus and cardiospasm the spasmodic element can be entirely eliminated by deep general anesthesia.

In case of large foreign bodies general anesthesia adds enormously to the danger of respiratory arrest

from pressure of the foreign body on the trachea and on the peripheral respiratory nervous mechanism.

The use of a general anesthesia will greatly lessen the need for skill in the introduction of the esophagoscope; but such use is utterly unjustifiable.

Local anesthesia is needless for esophagoscopy. If used at all it should be applied only to the laryngopharynx. The esophagus is not sensitive, as anyone can determine for himself by swallowing tea uncomfortably hot. No sensation is felt after the cricoid is passed.

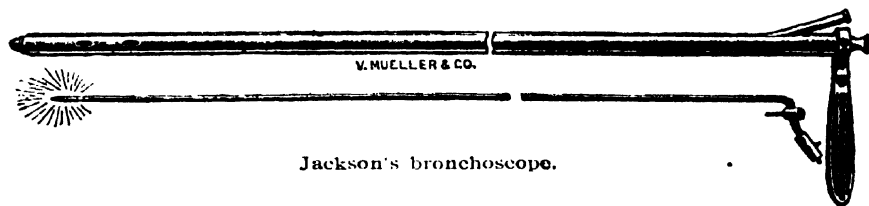
For pharyngolaryngoscopy or nasopharyngoscopy with the Hays or Beck pharyngoscope or similar instruments, no anesthesia is required

accurate work in the removal of laryngeal neoplasms, but such cases are exceedingly rare.

For certain laryngeal growths, such as small angiomas and edematous tumors that shrink so much under cocaine as to render accurate removal difficult, general anesthesia may be necessary.

For diagnosis in children no anesthesia, general or local; in adults local anesthesia of the larynx in some cases; none at all in others. Rarely, local anesthesia of the trachea and bronchi, as well as the larynx, will be needed.

For foreign bodies in the trachea and bronchi of infants and small children no anesthetic, general or local, is needed, except possibly in



Jackson's bronchoscope.

except in relatively rare instances, when the local application of a 4 per cent. cocaine solution to the fauces is sufficient.

For diagnosis: In infants and children no anesthesia whatever; in adults who tolerate indirect laryngoscopy well no anesthesia, general or local, is needed.

Foreign bodies: In infants and children no anesthesia, general or local.

For the removal of foreign bodies from the larynx, both local and general anesthesia should be avoided, lest their application lead to dislodgment of the intruder.

For papillomata in children no anesthetic, general or local, is needed. In adults local anesthesia is usually necessary for accurate work in removing specimens or entire neoplasms of any kind.

In a few adults with intolerant and uncontrollable general excitability and in some cases of hysteria a general anesthetic may be necessary for ac-

curate work in the removal of laryngeal neoplasms, but such cases are exceedingly rare. Foreign bodies in the trachea and bronchi of adults can often be removed without any anesthesia, general or local; but in many cases local anesthesia is needed. General anesthesia is only needed in complicated cases where there is a stricture to dilate to reach the foreign body, or where the mechanical problem of removal is complex.

For the treatment of stricture local anesthesia is sufficient, and in some cases none is needed, because tolerance to manipulation becomes established after repeated passage of the instruments.

Tracheotomy.—If lower bronchoscopy is ever justifiable it is only so in cases with extremely severe dyspnea. Even in such cases the facile operator will slip in a bronchoscope, through which, with the aid of amyl nitrite and oxygen, artificial respiratory aid can be supplied with greater facility than through a tracheotomy.

It never need be done under general anesthesia, and in a dyspneic case general anesthesia is utterly unjustifiable, because, as soon as anesthesia begins, respiration ceases, owing to the loss or the aid of accessory respiratory musculature. The personal preference of the author, as between upper and lower bronchoscopy for any and all purposes, is in absolutely all cases for upper bronchoscopy, even if a tracheotomy had been already done. Chevalier Jackson (*The Laryngoscope*, Oct., 1912).

With the laryngeal separable speculum of Jackson, and with his new modification of this instrument designed for examining the mouth of the esophagus, in which the spatula end is considerably elongated, a complete view of the larynx and of the mouth of the esophagus can be obtained. A better view of the anterior portion of the glottis and an easier introduction of the Jackson bronchoscope may be secured by making external counterpressure on the larynx. Brünings has devised an instrument that makes counterpressure on the larynx by pressing it inward against the vertebrae. This necessitates less pressure on the epiglottis in the introduction of the tube spatula, exposes fairly the anterior angle of the glottis, gives a more continuous presentation of the larynx, and also allows the more ready introduction of the bronchoscope.

In place of Brünings's counterpressure method, an assistant can make pressure on the neck over the prominent point of the larynx, pressing the larynx directly backward. Brünings writes that with the counterpressure method he was enabled to remove a polypus situated on the anterior third of a man's vocal cord, although previously not even the posterior wall

could be brought into view. With this method he believes that the applicability of endoscopy may now be reckoned at 100 per cent.

By means of the laryngeal speculum, foreign bodies may be gotten out from the larynx and the mouth of the esophagus, papillomata may be removed, and direct cauterization in laryngeal tuberculosis and surgical technique may be carried out—and this with much less traumatism and greater surety than by the old, or indirect, method, in which angular, instead of straight, instruments are used, and in which the mirror reverses the image anteroposteriorly.

The writer places the patient flat on the back with the head turned on the left cheek, and then, usually under ether anesthesia, he uses a bivalve speculum which he has devised and which is a combination of a tongue depressor and mouth gag, made for use upon the left side so that the operator can have his right hand for the manipulation of instruments. It exposes a larger field to vision than any other device hitherto employed, and utilizes the shortest anatomical route to the laryngeal and esophageal cavities. Mosher (*Boston Med. and Surg. Jour.*, Feb. 6, 1908).

In dubious cases, instead of wasting valuable time, the practitioner should resort to endoscopy, which may clear up the diagnosis in a moment. Besides the disturbances from a foreign body in the air passages, the writer has had 6 recent cases of hemoptysis or dyspnea which endoscopy explained as due to a primary sarcoma in a bronchus or carcinoma in the lung, or stenosis from a goiter or aortic aneurism. Ephraim (*Med. Klinik*, Apr. 30, 1911).

Suspension Laryngoscopy.—Kilian's new method of suspension laryngoscopy with the head in a swinging position promises to take

the place of the tube spatula in all prolonged examinations and operations on the larynx. Only two instruments are essential—the hooked spatula and the supporting apparatus.

The writer in experimenting on the cadaver was astonished at the way in which the throat was opened up for visual inspection when the head was allowed to hang down over the edge of the table, suspended merely by a tongue spatula fastened by an extension to a frame attached to the table above. The whole weight of the head is thus borne by the parts against which the spatula presses; the throat yawns and one can see the entire cavity of the larynx and for some distance into the trachea. He has applied the method to 20 patients and has found that it immeasurably facilitated operations on the throat in both children and adults. The procedure was borne with remarkable ease and no disturbance except a depression left in the tongue from the groove in the spatula; the spatula now used has no groove. Killian (*Berl. klin. Woch.*, Mar. 25, 1912).

If local anesthesia is used, a 20 per cent. solution of cocaine is applied to the base of the tongue and the interior of the larynx. General anesthesia is preceded by morphine, $\frac{1}{6}$ grain (0.01 Gm.), and scopolamine, $\frac{1}{200}$ grain (0.0003 Gm.). The first dose is given two hours before and the second dose one hour before operation. In children no morphine should be used. Etherization may be continued through a Nélaton catheter in the nose.

The patient is placed on the table with the head extended beyond its edge, in a swinging position. The hook is attached, and the vertical bar adjusted to the correct height. The instrument is introduced in the same way as the laryngeal speculum, the

retracting force being applied to the epiglottis and the base of the tongue. The laryngoscopic picture is excellent, and a good view is obtained of the pharynx, the faucial pillars, and tonsils, as well as of the hypopharynx. As the tongue is out of the way, one may look directly into the larynx and trachea; pathological conditions may be easily demonstrated, and suitable photographic reproductions made.

The opening of the larynx, being in direct line of vision, can easily be sponged free from blood and secretions. This enables the operator to make a longer and more thorough examination and to do more complete operations. He can, for instance, remove in one sitting small and not easily accessible growths or curette the larynx entirely free of tuberculous granulations. L. G. Kaempfer (*N. Y. Med. Jour.*, Jan. 4, 1913).

In the method of swinging laryngoscopy both the operator's hands remain free for any necessary manipulation. Finer technique is possible when the left hand is not being employed for forced retraction of the tongue and epiglottis, as in direct laryngoscopy. Killian uses this method more especially for the treatment of laryngeal tuberculosis, curettage, galvanic cauterization, the application of lactic acid, and the removal of laryngeal papillomata. He also finds that tonsillectomy in children is more easily accomplished by this method. He claims that all the manipulations are easy, and, hence, may be carried out with much more delicacy, and with greater improvement on the part of the patient as the result of better treatment. In one case he was able to demonstrate direct laryngoscopy to 120 physicians. This indicates the length of time that is at

the disposal of the operator for examination and operation.

BRONCHOSCOPY. — Bronchoscopy, practised for the removal of foreign bodies from the bronchi or the trachea, may be either an upper or a lower bronchoscopy. Upper bronchoscopy is the passing of the

bronchi, in his and Ellen Patterson's practice, in infants under 1 year—the youngest being 2½ months—there was not one case of subglottic edema. He is of the opinion that tubes of excessive size are usually employed in the cases of children, under the incorrect impression that the glottic



Position of second assistant, and endoscopy per os. Gowns, caps, and covers are omitted, better to show the positions. (Jackson's "Tracheobronchoscopy.")

endoscopic tube through the larynx, while in lower bronchoscopy the tube is passed through a tracheotomy wound. Lower bronchoscopy, when practised, is usually employed in the cases of children under 2 years of age, as infants are more subject to subglottic edema. Jackson always uses peroral endoscopy, and states that, among 30 successful cases of removal of foreign bodies from the trachea and

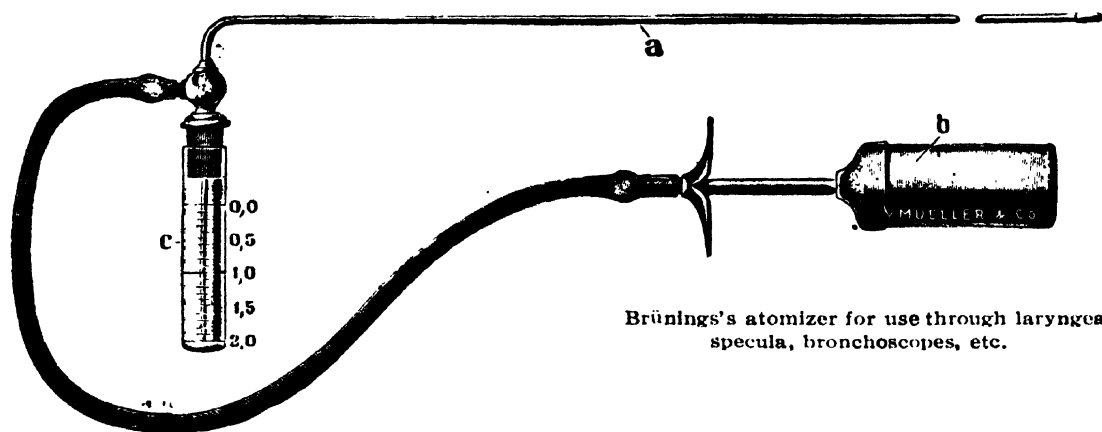
opening is more easily stretched in them than in adults.

The writer has used the bronchoscope in 15 cases. It revealed the foreign body in 12 and demonstrated its absence in 2 others. Bronchoscopy can never be applied too early. Eicken (Deut. med. Woch., Apr. 23, 1908).

The fact that 105 deaths are recorded in one paper in five years from foreign bodies in the throat, or

from ill-advised efforts for their removal, indicates the need of acquainting the medical public with the advances that have been and are still being made in bronchoscopy and esophagoscopy. The writer reports cases illustrating the dangers of the existing ignorance; in 1 case a penny had lodged in the esophagus and the patient succumbed to inflammation due to blind probing without the use of the esophagoscope. In another a prominent surgeon did a rapidly fatal thoracotomy for a glass bead which at autopsy was found in the right bronchus. The operating surgeon, when his attention was called to this

certain to irritate this space. Analysis of the 19 cases reported shows that the size of the tube used in bronchoscopy was too large for the diameter of the subglottic space, judging from the child's age. The longer the interval before removal when a smooth body like a bead had been propelled by the breath again and again against the glottis, the greater the inflammation. The writer's study of the subject shows that any pronounced swelling in the subglottic region should contraindicate bronchoscopy from above. Killian (*Deut. med. Woch.*, June 29, 1911).



Brünings's atomizer for use through laryngeal specula, bronchoscopes, etc.

and the fact that it could have been easily removed by bronchoscopy, asked: "What is bronchoscopy?" Chevalier Jackson (*Jour. Amer. Med. Assoc.*, Sept. 25, 1909).

The writer reports 19 cases, some from his own experience, in which after removal of the foreign body the dyspnea increased after a longer or shorter interval and intubation or tracheotomy became necessary a few hours to a few days later. He is convinced that this occurrence is even more frequent than is shown by the records, and his experiments on the cadaver have revealed the explanation, namely, that the subglottic passage is much narrower than generally supposed and the foreign body, especially if it is one that is forced back and forth by the breath, is almost

When patients come in with very severe dyspnea, early tracheotomy is necessary. If they become dyspneic within thirty-six hours after the introduction of the bronchoscope, Jackson believes it is due to the collection of a large quantity of mucus in the lungs. He, therefore, reintroduces the bronchoscope and removes the mucus, when normal breathing is quickly re-established. The collection of mucus in children takes place owing to the fact that they expectorate with difficulty, and places them in the danger of drowning in their own secretions.

Bronchoscopy for the removal of foreign bodies should be practised in

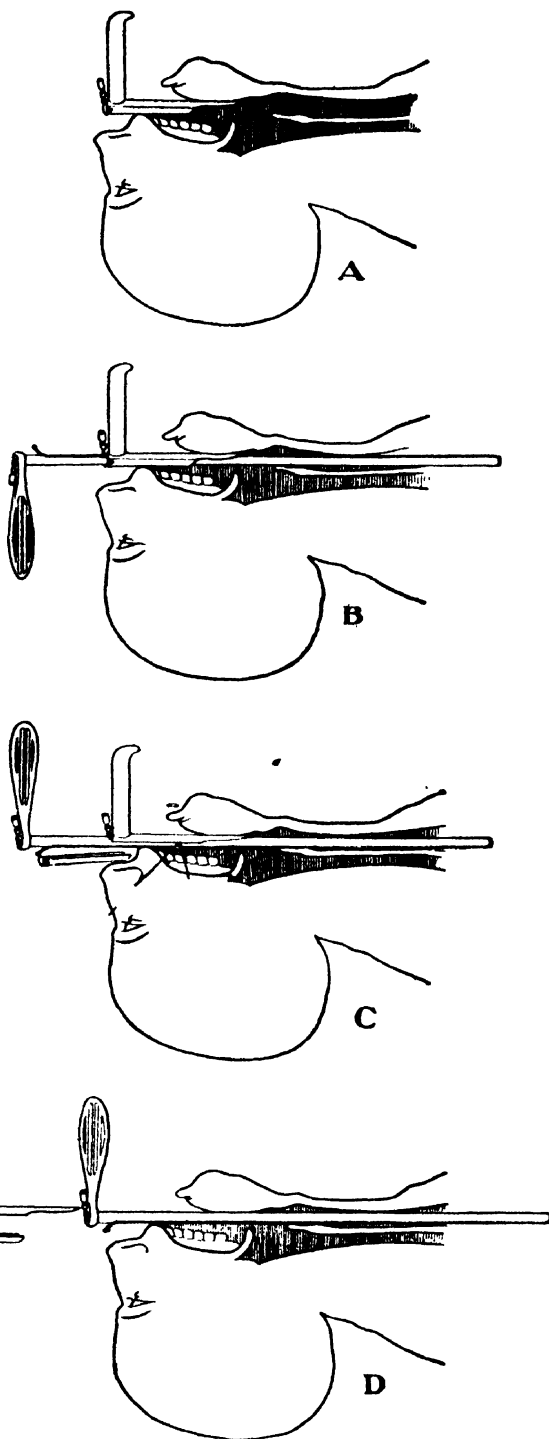
the dorsal decubitus, preferably in the Boyce position. If local anesthesia is used in tracheobronchoscopy, it is preferable to employ cocaine on the laryngopharynx, to abolish the reflexes, and to use novocaine or alypin in the trachea or bronchi. In anesthetizing the trachea or bronchi for the removal of a foreign body, it is best to employ a spray, as an applicator may dislodge the foreign body. In children the use of cocaine is never justifiable, as they are exceedingly susceptible to the toxic effects of this drug.

General anesthesia should be by means of ether. This is to be preferred when the foreign body is large or has sharp edges, as general relaxation of the muscles is required in such cases.

Jackson uses either general or local anesthesia in children under 6 years of age, except when a very sharp foreign body has been swallowed, such as a safety-pin or a fishhook, threatening perforation from coughing or vomiting; and not even in these cases, if there is dyspnea. In his last 107 bronchoscopies and esophagoscopies in children under 6 years of age no anesthetic was employed.

The writer's new method of passing the bronchoscope in the straight position has worked admirably and has proven very easy. The method is as follows:

The patient is placed on the table with the head in the normal straight position. A general anesthetic is administered. The modified direct laryngoscope is passed straight down between the incisor teeth, and when the epiglottis comes into view the spatula end of the instrument is hooked behind it. By making slight pressure on the upper teeth the epiglottis and base of the tongue



Schema illustrating upper tracheobronchoscopy.
(Jackson.)

are pulled up and the larynx opened for inspection. A weak solution of cocaine is now applied to the

larynx through the tube to prevent reflexes. With the laryngoscope in position, the bronchoscope is passed through it to the vocal cords. With the eye fixed on the end of the smaller tube, a slight twisting motion is used, which sends the bronchoscope between the cords. The breathing is now distinctly tubal in character. The laryngoscope is removed and the head of the patient gently lowered over the end of the table. The examination is now proceeded with as in the extended position. In the above procedure the operator stands to the left of the patient and uses the laryngoscope in the left hand. Both direct laryngoscopy and bronchoscopy are easier because the muscles are relaxed. Johnston (Maryland Med. Jour., June, 1911).

Foreign Bodies in the Bronchi.—

The diagnosis of foreign bodies in the bronchi proves, at times, very difficult. The patient should be subjected to searching questioning as to the possibility of his having swallowed a foreign body. In many cases it has happened that the patient's statement of the fact that his cough and expectoration followed the swallowing of a foreign body has been disregarded and a diagnosis of tuberculosis made. Guisez gives the history of a young girl who exhibited all the signs of emphysema; she had stated, to all the physicians that she had consulted, that the trouble dated from her swallowing a piece of raw chestnut. Finally, in a violent fit of coughing, a piece of the shell of a chestnut was expectorated, after which all the symptoms subsided. This author says that at the autopsy in a certain number of cases of fatal pulmonary affections a foreign body has been found. Of all signs, the most important, according to Guisez, is the functional sign consisting of parox-

ysms of coughing that have been present since the swallowing of a foreign body. The cough in such cases is loud, barking, and spasmodic, and is almost always accompanied by an attack of suffocation, which varies in severity according to the situation and size of the foreign body and according to whether it is fixed in the walls of the bronchi or lies loose in the trachea.

Dyspnea develops when the foreign body is large or is liable to swell (beans, nuts). If the foreign body is septic, there is purulent expectoration, which becomes profuse and bloody. If the foreign body is pointed, there may be attacks of hemoptysis, resulting in a diagnosis of tuberculosis. In other cases the signs are entirely latent. Especially is this the case if the foreign body is small and is embedded in the wall of a small bronchus.

The *physical signs* of foreign body in the trachea or bronchi are stated by Guisez as follows: If the foreign body is free in the trachea, the sounds produced occur during inspiration, and are sometimes audible to the patient. In the bronchi, if the body is large, there is suppression of sounds over that part of the lung which corresponds to the obstructed bronchus. The chest of that side will, in addition, show a corresponding loss of movement. When the foreign body is small, the signs are those of bronchitis. Other signs may be due to the special character of the foreign body. In one of Guisez's cases, in which the reed of a trumpet had entered the respiratory tract, a faint musical sound issued at each fit of coughing.

The use of the radiograph, of all methods, gives the most definite diag-

nostic information, when the foreign body is of such a character as can be shown on an X-ray plate. Guisez states that radiographs should be made during a period of suspension of respiration. This is possible in adults only. The pictures should be made in an oblique position, and taken from several directions.

The *prognosis* depends on the character of the foreign body inhaled. If the latter be large, immediate suffocation supervenes, as is also the case with small bodies when there results violent spasm of the glottis.

Case of removal by upper bronchoscopy of an open safety-pin which had been swallowed during laughing by a girl of 13. The skiagraph showed the pin in the trachea. The flat square head of the pin came almost immediately into view and by means of the special instruments devised originally by Dr. Algernon Coolidge, Jr., of Boston, the distant spiral end of the pin was engaged in the ring and the pin was closed with a forked probe. When attempting to withdraw the bronchoscope and instrument with the pin attached, it was found impossible and the writer decided to withdraw the two instruments into the tube, first, the pin pusher and then the ring instrument, and the pin came out on the end of the ring, which snapped off before they could see how it was engaged. It was then with considerable difficulty that the glottic spasm was overcome and the tube removed from the larynx. The patient bore the anesthetic and the operation well without loss of blood or serious effect. G. Hudson-Makuen (Jour. Amer. Med. Assoc., July 22, 1911).

Endoscopic Treatment.—The endoscopic treatment of diseases of the bronchi promises to open up a new field in the therapeutics of bronchorrhea, bronchiectasis, ulcers of the

bronchi, and asthma. In the last volume of Katz's work Mann refers to the difficulty of practising bronchoscopy in bronchiectasis on account of the profuse secretion, and gives Schrötter's review of 9 cases, not all of which were positive. In the positive cases there were redness and swelling of the mucous membrane, together with localized elevations and puffiness.

[CASE I. For four weeks the patient had had constant cough and hoarseness, and for fourteen days a purulent secretion. On the left side there was a large area of dullness. After the first treatment there was marked improvement, and by the end of three weeks complete cessation of all irritation. The mucous membrane was no longer pathological in appearance.

CASE II. On clinical examination the whole left lung seemed to be involved in one large, bronchiectatic cavity. Schrötter undertook to perform a pneumotomy. The patient, after ten days, developed aspiration pneumonia of the sound side, which was followed by endocarditis and finally by death.

CASE III. In a case of Ephraim's a man 21 years old had cough and expectoration, and there was dullness under the left scapular angle. Bronchoscopic examination revealed marked redness of the mucous membrane. At a depth of 34 cm. there were 3 red, swollen, elevated areas, covered with flakes of pus. After 24 treatments with a 10 per cent. emulsion of turpentine oil—up to 10 c.c.—extending over a period of five months, there was marked improvement.

Mann also describes 2 rapidly progressive cases in which the difficulty in making the examinations was very great. In the first the treatment produced no change. In the second it resulted in a diminution of the fetor.

The author's case of bronchiectasis was one of ten years' standing in a woman of 22 who expectorated 500 c.c. of fetid, grumous, bloody sputum in twenty-four hours. Physical examination revealed fine râles, which were always present, over the apices. Coarse râles were heard

over the clavicle. There was marked bronchial breathing. The temperature reached 100° F. The patient weighed 98 pounds and had broadened finger-tips. A bronchoscopic examination showed the mucous membrane of the right bronchus to be grayish and thickened, with numerous points of ecchymosis. After failure of eucalyptol to benefit the condition, the following treatment was instituted: The patient was placed in the Trendelenburg position for half an hour, to drain out the bronchi. After induction of local anesthesia, a Jackson speculum was used to expose the glottis, and a long rubber catheter, with a 25 cm. probe as obturator, introduced down into the right bronchus. The probe was then withdrawn, and 30 minims (2 c.c.) of a freshly prepared 25 per cent. argyrol solution were injected. At home the patient daily assumed the Trendelenburg position, and at night the foot of the bed was raised. After the third treatment all bleeding ceased; after the tenth, expectoration was reduced to 20 c.c., and, after the fifteenth, cough entirely ceased. After this time the patient brought up only about 5 c.c. in the course of twenty-four hours. Her weight was 118 pounds. Improvement continued, and when she was last seen there was improved aëration of the blood, as shown in a diminution of the pneumoarthropathy of the finger-tips. E. E. Musson.]

Schrötter, Ephraim, and Nowotny examined and treated a number of cases of bronchial asthma. Ephraim in only a very small percentage of cases found redness and swelling of the mucous membrane and contraction of the lumen. These positive findings seemed to be associated with bronchitis. Schrötter believed the trouble to be in the smaller bronchioles, too deep for inspection. He proposed that the asthma should be treated with cocaine and epinephrin, to abort the attacks. Nowotny carried out this treatment with surprising results.

Ephraim perfected the treatment by

the introduction of his flexible spray apparatus, using a novocaine-epinephrin solution. By this method he was able to reach the smaller bronchi. In 133 patients treated by this means the results were surprising, even after one treatment and in cases of many weeks', months', or even a year's duration. In but few cases was there no result. In these, according to Ephraim, the nervous component was more pronounced than the chronic catarrhal process. Nowotny believes that the ischemic action of cocaine-epinephrin solution is undoubtedly the main factor in the amelioration of the symptoms of asthma. Another factor is the establishment of expectoration in all his cases after every treatment. According to his experience, the bronchoscope is one of the most energetic of expectorants. By no other method is there provoked so great a secretion in such a short time as by endoscopy of the bronchi. Nowotny believes in the reflex nervous origin of the disease, and holds that the irritation of the vasomotor nerves of the lung leads to tumefaction and hyperemia of the bronchial mucosa, as well as to exudation, this practically constituting the physical basis of the attack of asthma.

Tuberculosis of the Trachea.—

Mann, in Katz's work, states that up to the present time tuberculosis of the trachea has been treated bronchoscopically by von Schrötter only. Schrötter's patient had all the symptoms of pulmonary tuberculosis, with dyspnea and marked stridor. On examination there was found, 18 cm. from the teeth, a nearly circular area of infiltration, with large, miliary tubercles. The stenosis was successfully reduced by three systematic

dilatations with flexible bougies. A return of dyspnea eleven months later was treated by means of flexible metal tubes. The patient lived for two years and a half. No autopsy was allowed.

Syphilis of the Trachea.—Mann, who has had 31 cases under observation, states that the tracheal lesions of syphilis usually appear about ten years after the initial lesion. The clinical signs are marked dyspnea, cough, and the expectoration of bloody sputum. Endoscopy aids in determining the exact stage of the disease. One case will show granulations; another, infiltration, with or without ulceration; another, only scars, and still another, all these lesions combined. Some of the patients improved under **salvarsan**. **Potassium iodide** should be given cautiously, for fear of sudden swelling, which might prove fatal. During specific treatment, the course of healing may be observed bronchoscopically; granulation tissue may be destroyed, and stenosis prevented, by early dilatation. The danger attending the endoscopic treatment is emphysema of the lungs and skin, or rupture of a peritracheal abscess or of large vessels if they are eroded. Complications such as pneumonia or tuberculosis may appear. Of the 31 patients under observation, 7 died. Considering the severity of the disease, this is a small number, and proves the life-saving influence of tracheoscopic management in these cases.

Intratracheal Anesthesia.—Chevalier Jackson, in describing the technique for the insertion of intratracheal insufflation tubes for etherization, states his belief that the larynx should

be inspected before the insertion of the tube, in order to see whether there is any disease present and to determine the extent of the lumen of the larynx, so that a catheter of proper size may be used. He gives six rules for the introduction of the catheter:—

1. The patient should be gotten fully under the anesthetic by the open method, so as to get full relaxation of the muscles of the neck.

2. The patient's head must be in full extension, with the vertex firmly pushed down toward the feet of the patient, so as to throw the neck upward and bring the occiput down as close as possible beneath the cervical vertebræ.

3. No gag should be used, because the patient should be sufficiently anesthetized not to need one, as well as because wide gagging defeats the exposure of the larynx by jamming down the mandible.

4. The epiglottis must be identified before it is passed.

5. The speculum must pass sufficiently far below the tip of the epiglottis to prevent the latter from slipping.

6. Too deep insertion must be avoided, as in this event the speculum goes posterior to the cricoid, and the latter is lifted, exposing the mouth of the esophagus—which is bewildering, until sufficient training of the eye enables the operator to recognize the landmarks.

The most important thing of all is the position of the patient; next to that comes recognition of the epiglottis, and next the proper motion of lifting the hyoid bone to expose the larynx.

Jackson's modified laryngeal speculum, with the slide opening on the

side instead of the top, may be used. The slide is removed for introduction, as the catheter can be slipped out laterally and the speculum removed. Jackson states that in introducing this catheter it should be remembered that the trachea does not go perpendicularly downward, but backward and downward. He refers to his observations in 80 cases of postanesthetic laryngoscopy in which there were no reactions in the larynx, even after prolonged anesthesia. He considers that there is less irritation of the larynx from an intratracheal insufflation than from an anesthesia of a corresponding duration by the open method.

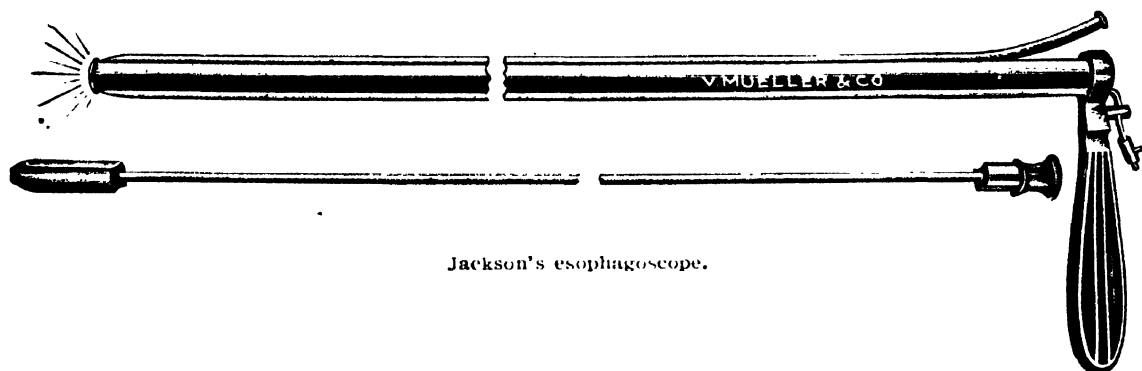
ESOPHAGOSCOPY. — For the purposes of foreign-body removal, esophagoscopy has resulted in the discarding of the older method of using the umbrella probang and the coin catcher. In a large majority of cases a foreign body swallowed lodges in the hypopharynx and behind the cricoid cartilage, above the mouth of the esophagus. The arytenoid cartilage and the cricoid cartilage are in direct apposition to the vertebral column, as can be demonstrated externally by moving the pharynx to and fro on the vertebra, producing a crackling sound. On indirect laryngeal examination, according to Killian, the entrance into the esophagus is seen as a slit only, posterior to the arytenoid. Upon phonation; the arytenoids move forward, and their posterior surface comes into view. This increases the space between the arytenoids and the postpharyngeal wall. By introducing a von Eichen probe into the larynx and lifting the larynx upward and forward, the upper two-thirds of the posterior surface of the

cricoid may then be seen. The hypopharynx has now the appearance of a funnel with a slit-like opening at its base representing the opening into the esophagus, the mouth of the esophagus being only 1 cm. below this. Beyond that point the esophagus is open. The mouth of the esophagus is governed by a sphincter muscle, which is innervated by the glossopharyngeal nerve. This nerve has the power of arresting deglutition, and this explains the fact that foreign bodies or liquids to which the pharyngeal mucous membrane is not habituated are arrested at this point of the alimentary tract. By means of esophagoscopy, Killian has frequently been enabled to see a foreign body arrested at a point posterior to the cricoid, and just at the mouth of the esophagus. From there they were easily liberated, and disappeared down into the esophagus. Observations made after the swallowing of corrosive liquids have shown this to be one of the points of the alimentary canal at which burns are most frequently found. In a case of foreign body in the esophagus Killian made the mistake of thinking that he had to do with an inflammatory swelling, this appearance being caused by the contraction of the sphincter muscle at the mouth of the esophagus around the foreign body and the fact that the mucous membrane was of a dull-red color.

It is most important to recall the anatomy of the hypopharynx in attempts at removal of foreign bodies in this region. Such instruments as the coin catcher, the umbrella horse-hair probang, and even the forceps (when introduced without illumination) are calculated to push the for-

eign body, lodged in the hypopharynx, down into the esophagus. The majority of foreign bodies swallowed are either coins or fragments of bone. If the coin is large or the bone has sharp angles, this method of attempting removal results in impaction of the foreign body in the walls of the esophagus, and when the foreign body is a piece of bone or an artificial denture severe wounds and perforations of the esophagus, with infection of the mediastinum and death, have been reported. Killian gives a detailed description of a case in which a patient,

of foreign bodies behind the cricoid. With this instrument and a long pair of forceps, many bodies arrested in the hypopharynx or within the mouth of the esophagus can readily be removed. The technique of hypopharyngoscopy is not difficult, and the apparatus is very simple. Jackson's new esophageal speculum consists merely of the laryngoscopic speculum with a lengthening of the spatula which permits of introducing the instrument behind the cricoid. The entire instrument is 25 cm. long. The use of this instrument prevents over-



Jackson's esophagoscope.

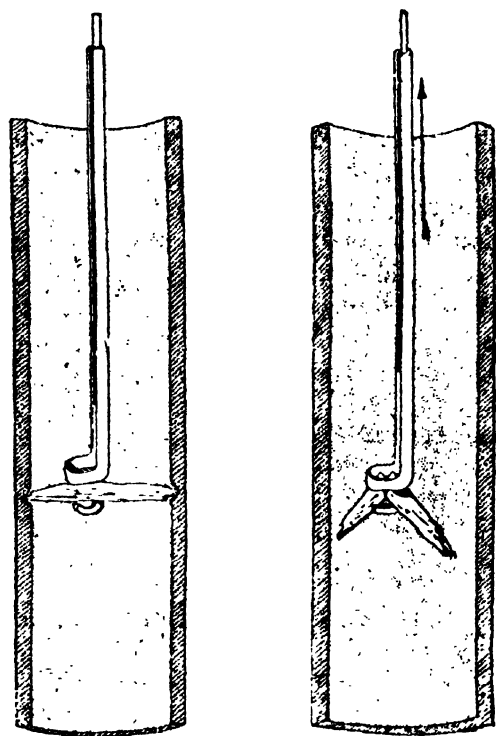
feeling that a piece of bone was lodged in the throat, succeeded in getting it down into the esophagus by eating dry bread. Later, a physician attempted to push it down into the stomach by means of a sponge probang and instruments. Under direct illumination Killian found a severe wound of the esophageal wall, and removed the bone with difficulty. Later, the mediastinum was opened, to seek for a perforation. This was found only at autopsy, which revealed a tear 5 cm. long 10 cm. below the cricoid.

Hypopharyngoscopy with Jackson's new esophageal speculum should be a routine preliminary procedure when the symptoms indicate the lodgment

of foreign bodies in this region, as might occur in using the esophagoscope. The mandrin in the esophagoscope has now been entirely discarded, thus eliminating all blind examination of the esophagus, as the instrument is always passed by sight.

In cases in which unsuccessful attempts at removal by the older methods have previously been made the prognosis is much graver than in those in which there have been no attempts at interference, for in the former cases the esophageal wall has been wounded or torn, and even after the removal of the foreign body the patients succumb to mediastinal infection. The esophageal wall is thin and easily lacerated, and when foreign

bodies are found to be deeply impacted forcible removal should never be attempted. Efforts should rather be directed toward crushing the body, or, as in the case of an artificial denture, cutting it into two. Killian succeeded in removing such an artificial denture by morcellation. An effort should be made to close a safety-pin



Breaking a piece of bone imbedded in the esophagus. (Guisez.)
(Annales des mal. de l'oreille, etc.)

before attempting to extract it, or, if the foreign body is a long stick-pin, it should be cut into two, and the two ends extracted separately.

[In Jackson's report of 206 cases of esophagoscopy for foreign body occurring in his service in Pittsburgh and in his work in other cities, there are cited 198 successful extractions, the foreign body escaping downward in but 8 instances. There were 4 deaths, 1 being in a patient with advanced nephritis. The other 3 patients had been admitted with severe

lacerations of the esophagus from previous attempts at extraction.

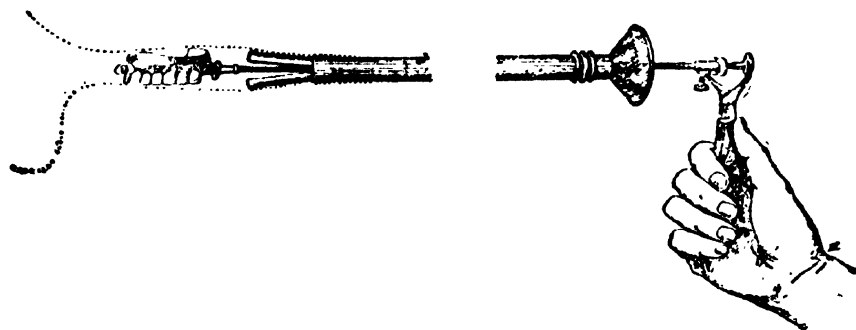
Guisez in 1911 reported a number of cases of removal of foreign bodies from the esophagus. The ages of the patients varied from 11 months to 81 years. Illustration was afforded of the fact that infants swallow all that is brought to them, while old patients, by reason of their poor dentition and mastication, are apt to swallow inadvertently such articles as pieces of bone or, during sleep, artificial dentures. Dysphagia Guisez found to be the most constant symptom, pain being variable. The length of time the foreign body remained in the esophagus varied from four minutes to several hours. The tolerance of the esophagus to foreign bodies proved to be most marked in the case of coins. In one instance a child retained for four years and without any complication a ten-centime piece (a copper coin about the size of a silver half-dollar) at the upper third of the esophagus. The diagnosis was best made by the history, the dysphagia, and, finally, the radiosopic findings. The largest foreign body that Guisez extracted was an artificial denture 6.5 cm. in its largest dimension. It was only by fracturing it that he was enabled to effect removal. E. E. MUSSON.]

When large pieces of bone are swallowed and the points are buried in the esophageal wall, it is necessary first to break the bone in the middle. The principal factor that fixes the foreign body is the local spasm of the sphincter fibers. This is only slightly overcome by general anesthesia, and it is necessary to use cocaine; then the spasm is immediately relaxed, and frequently the foreign body is swallowed.

When the foreign body is very large, Guisez uses a dilating tube, of which the two extremities open above the foreign body, and thus protect the wall of the esophagus. A rubber artificial denture can be divided by means of a chain saw protected by a curved beak.

Esophagoscopy is also applicable in the diagnosis and treatment of various pathological conditions of the esophagus, such as **diverticula, ulcerations, strictures, dilatations, esophagismus, and cancer.** Its use renders possible the early diagnosis of esophageal cancer and the resection

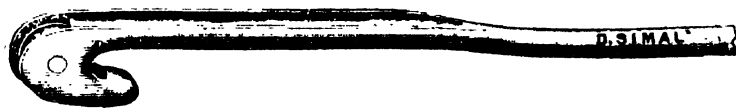
gismus. Spasm occurring below this should be called *abdominal esophagismus*, as the entire abdominal esophagus is involved in this spasm. The word *cardia* is properly used as the name of the esophageal orifice of the stomach. Spasm here is exceedingly rare.



Use of dilating tube in the removal of a denture from the esophagus. (Guisez.)
(Annales des mal. de l'oreille, etc.)

of the thoracic esophagus. The present mortality in cancer of the esophagus is 100 per cent. In these cases Jackson has found esophageal intubation very satisfactory, the patient being enabled to swallow liquids, and even finely masticated food. Some of his patients have worn these tubes for a number of months without their exciting ulceration.

[Guisez reports 4 cases of **congenital stenosis of the esophagus** diagnosed by means of esophagoscopy. These were the only cases observed in 1400 esophagoscopies. In all instances the stenosis occurred in the region of the *cardia* in males from 10 to 30 years old. A previous diagnosis of grave spasm of the esophagus had been made. In the region of the *cardia* there is seen a species of valvular formation, more or less inflamed, modified by esophageal peristalsis, but always



Curved beak serving as guide for chain saw in dividing hard-rubber dentures. (Guisez.)
(Annales des mal. de l'oreille, etc.)

Jackson would restrict the meaning of the term *cardiospasm*, and introduce two others, referring to distinct clinical types of spasm of the esophagus. One of these is for spasm at the *hiatus esophagi*; from its location and from the fact that it is the diaphragmatic, and not the esophageal, musculature that is active, this should be called *phrenospasm* or *hiatal esopha-*

preserving its characteristic appearance and its easily recognizable border. The prognosis in such cases is grave. The treatment employed by Guisez was as follows: 1. Esophagitis reduced by means of diet and lavage of the esophagus four times a day with alkalinized water. 2. Opening dilated with olivary filiform bougies, left in for several hours. It is nearly always necessary actually to cut the valvule by esophagotomy. In the last 3 cases Guisez used circular elec-

trolysis, owing to a concomitant stenosis. In all the cases reported food was soon being taken normally. E. E. MUSSON.]

TRAINING IN ENDOSCOPIC TECHNIQUE.—Training for endoscopic work in the removal of foreign bodies is best gained by practising the passing of instruments on the cadaver and on the dog. When practising on the latter, a hypodermic injection of scopolamine and morphine should be used, followed by ether. Clinical training may be gained by direct laryngoscopic examination in children suffering with attacks of dyspnea. In adults examination may be made in all laryngeal involvements—papilloma, laryngeal paralysis, etc. In examining the hypopharynx of adults for foreign bodies, good clinical training may also be obtained; likewise in cases of esophageal dilatation. The examination of the bronchi in all cases of profuse purulent expectoration, bronchiectasis, and asthma affords good practice. If one employs a human subject to practise on, it is well to avoid selecting one with a short, muscular neck and long teeth.

In this preliminary work on the adult local anesthesia with epinephrin and cocaine is advisable at first, possibly with a previous hypodermic of atropine and morphine when the work is being done for diagnostic purposes. In infants and young children cocaine is contraindicated. Complete control of the young child is possible, however, if it is well wrapped up in a sheet and placed in the recumbent position.

It is advisable in this work to have regular assistants, in order that their training may be so perfected as to render their aid of value for emergency work in the removal of foreign bodies.

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LARYNX, DISEASES OF. LARYNGITIS.

DEFINITION AND VARIETIES.—The term "laryngitis" means inflammation of the larynx; but to distinguish properly the various inflammatory disorders to which this organ is liable, several types of laryngitis are recognized: *Acute laryngitis*, in which the mucous membrane alone is supposed to be inflamed; *edema of the larynx*, in which the deeper tissues become infiltrated; *symptomatic laryngitis*, in which edema and phlegmon may complicate acute laryngitis as a result of microbic infection; *chronic laryngitis*, in which any of the lesions of inflammatory origin observed in the foregoing varieties have assumed chronicity. These types include several disorders to which individual names have been given, but they appear to represent but stages or degrees of the classical forms.

ACUTE LARYNGITIS.

SYMPTOMS.—Acute laryngitis in the majority of cases is the result of the temporary extension of a chronic catarrhal process existing in neighboring tissues, especially the nose, the pharynx, or the tonsils. In professional singers, for instance, constant traveling, with its attending variations in climate and temperature, frequent exposure to dust and smoke, etc., generally keep up a catarrhal disorder of the nasopharyngeal tract. The hyperemia thus induced readily extends by continuity of tissue to the vocal organs under the influence of any undue exposure, dampness, cold, or any factor capable of irritating the laryngeal surfaces. The larynx in such cases may be said to be predisposed to a mild form of catarrh which appears more or less frequently. In



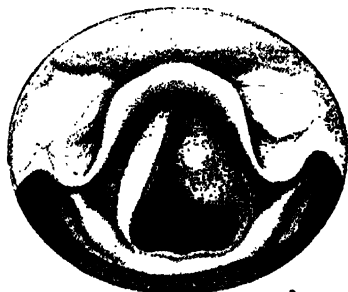
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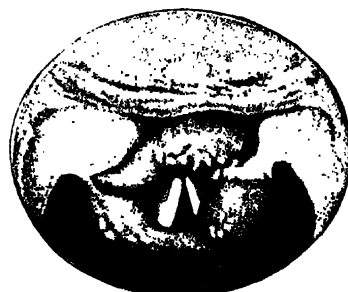
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ISCHEMIC, HYPEREMIC, AND NEOPLASTIC DISORDERS OF THE LARYNX.
(*Kreisg.: Kehlkopfkrankheiten.*)

1, anemia of the entire larynx and in particular of the tuberculous infiltration interarytenoid region. Earliest stage. 2, hyperemia of the entire larynx, particularly of the vocal cords. 3, nodular infiltration of the left vocal cord with preservation of the epithelial coat. 4, tumor-like infiltration of the left vocal cord with preservation of the epithelial coat. 5, nodular infiltration on the anterior surface of the posterior wall with intact mucosa. 6, pale infiltration of the posterior wall of the larynx in its entire thickness. 7, nodular infiltrations of the edematous epiglottis and arytenoid regions. 8, nodular infiltration of the edematous arytenoid region. Heart-shaped epiglottis. Swelling with granulations on the posterior wall. 9, nodular infiltration of the inflamed and swollen epiglottis. Arytenoid regions very pale and edematous. Vocal cords ulcerated.

such cases the subjective symptoms mainly consist in a sensation of tickling and soreness or irritation in the larynx, which causes the patient to cough, or produces a constant desire to "hem" and a feeling of constriction at the throat. The voice is altered in quality and pitch, and easily fatigued; it becomes gruff, and hoarseness, more or less marked, follows. Aphonia may even develop. Under the influence of proper treatment and rest the local hyperemia quickly subsides, but the continued use of the voice prolongs the inflammatory process and tends to permanently compromise the integrity of the organ as an instrument.

A laryngoscopical examination sometimes yields but little evidence of inflammation, the interarytenoid space alone showing slight hyperemia. In the vast majority of cases, however, the entire larynx shows congestion, the vocal bands being distinctly red. Much faith cannot be placed upon these signs in the case of male singers, however, the vocal bands being frequently pink and even red in the normal state; but in women, local redness usually means active congestion, unless the patient be addicted to excessive use of alcoholic drinks.

In persons in whom the voice is not subjected to more than ordinary uses an attack of acute rhinitis frequently precedes the laryngeal disorder. When, however, the laryngitis is primary, hoarseness usually occurs as the first symptom, though slight chilliness occasionally alluded to is a premonitory sign. The voice is lowered in pitch; a pricking sensation is experienced in the larynx, which causes hacking and aggravation of

the local congestion. There are usually some cough, slight dyspnea, and occasionally pain during deglutition and a slight rise of temperature. The mucosa is at first very dry, the dryness lasting from one to several days. Expectoration then becomes established and is thin and scanty, later jelly-like and viscid, and still later muco-purulent, and more copious. Hoarseness in the early stages is due to dryness of the mucosa, later to infiltration and thickening of the cords which result in a paresis of their delicate movements.

Laryngoscopically the larynx is found markedly congested, either diffusely or merely in the vocal bands and intra-arytenoid tissues.

Some cases of acute laryngitis are attended by hemorrhagic symptoms, the expectoration of blood usually following violent coughing. Besides the usual laryngeal manifestations, there is generally to be found a circumscribed patch, the seat of rupture of a superficial vessel. In some cases there is no expectoration of blood, but the vocal bands show a red spot of localized hemorrhagic infiltration. It sometimes shows itself independent of a catarrhal condition as a result of undue strain in using the voice. It is probable, however, that a latent catarrhal process is always present in such cases, and that the vascular walls are inordinately weak. (See colored plate.)

The rheumatic diathesis predisposes to a disorder of the larynx simulating acute laryngitis, but differing from it in that local phenomena are usually less active objectively. The voice is used with difficulty and the pain is sometimes much more severe than that experienced in other

inflammatory disorders. There is dyspnea in the majority of cases.

Rheumatism of the larynx sometimes occurs in conjunction with general rheumatism. It is a serious disorder, particularly in singers; one or both of the cricoarytenoid joints may be involved in the inflammatory process, and permanent hoarseness often results.

ETIOLOGY.—Generally speaking, laryngitis may be said to be due either to conditions causing local congestion by mere overuse or mechanical irritation, by continuity of tissue, or by chemical irritation.

The forms thought to be independent of specific germs are those due to exposure to cold and damp; the inhalation of smoke, especially tobacco smoke in a badly ventilated room; dust, irritating fumes, spices, irritating particles of all sorts, etc. Excessive use of the voice and the ingestion of alcoholic drinks, of hot or overspiced food, are also frequent causative factors.

As already stated, catarrhal diseases of the nose and nasopharynx greatly predispose to acute laryngitis, and the majority of cases witnessed show such a condition as a primary factor. Singers, army officers, ministers, etc., are especially prone to this disorder on this account, particularly when the voice is improperly used; but the presence of a primary catarrhal disorder of the nasopharyngeal tract may usually be discerned. Obstructive lesions within the nose, necessitating mouth breathing, may directly or indirectly be the causal agents. Cases are recorded in which the application of remedial agents to the pharynx has been followed by an attack of acute laryngitis produced

by the inhalation of the powder or liquid into the larynx. Irregularities of the gastrointestinal tract, especially in children, may be a predisposing factor. Men appear more susceptible to laryngeal irritation than women, doubtless because they are more readily exposed to professional and trade injuries and indulge to a greater extent in the abuse of alcohol.

PATHOLOGY.—In the idiopathic form of acute laryngitis the superficial vascular supply is mainly at fault and there are very few cases in which a certain amount of cellular infiltration does not occur, and the line of separation between the superficial and deeper changes is not easily discerned. The primary factor in such cases is probably vasomotor, and if the paresis of the vascular nerves is marked the serous infiltration by diapedesis into the tissues may be such as to give rise to slight tumefaction. The epithelium may be softened and, localized desquamation occurring, diminutive erosions are sometimes found.

Acute subglottic laryngitis (laryngitis acuta subglottica) is met with mostly in children, and may occasionally give rise to nocturnal attacks of stenotic dyspnea. The inflammation is here limited to the under surface of the vocal cords, and the swelling of the subglottic tissue may be sufficient to cause it to project beyond the borders of the cords.

TREATMENT.—The patient should be in a warm, moist room, refrain from talking and smoking, and not allow others to smoke around him. Hot food increases the local congestion, and especially the hot alcoholic drinks so frequently indulged in. Cracked ice and ice-cream

are usually grateful to the patient and beneficial to his throat.

An acute attack of laryngitis due to "cold" may often be arrested by the early internal use of **potassium bromide** and **opium**. Twenty grains of the former, with 2 drams of paregoric, repeated every three hours, usually reduces the laryngeal hyperesthesia which lies at the bottom of the local symptoms to a minimum, while the likelihood of any complication is greatly decreased. The somnolence also induced tends to reduce the localized congestion. After this effect is obtained, the dose may be reduced by half and taken every two hours, two or three times. A bottle of **citrate of magnesia** taken the next morning often brings on the stage of resolution. This may be encouraged by means of the official **compound guaiac lozenges**.

In some cases the **inhalation of steam impregnated with the compound tincture of guaiac** is quite effective, but not nearly as much so as the method given above, which it is calculated to replace when patient cannot take the bromides. One teaspoonful of the compound tincture is placed in a pitcher of water no hotter than the hand will stand comfortably for 10 seconds; the vessel is covered with a towel folded into the shape of a cone; the mouth and nose are inserted into the open top of the cone, and the steam is inhaled deeply as long as it is emitted.

A simple and effective inhaler may be made as follows: Take a pint or quart bottle with a wide mouth; place a cork or rubber stopper in the neck; bore 2 holes a quarter of an inch wide in the stopper; in 1 of the holes place a piece of glass tubing which reaches from a little above the stopper to within a half inch of the

bottom of the bottle; in the other hole place another piece of glass tubing reaching a quarter of an inch below the bottom of the stopper and extending upward for about 10 inches and bent at an angle of about 45 degrees at a point a short distance above the top of the stopper. In the bottle put enough warm, but not hot, water to a measure of $\frac{1}{4}$ or $\frac{1}{3}$ the capacity of the bottle. Pour into the water $\frac{1}{2}$ to 1 teaspoonful of the following:

R *Mentholis* gr. v (0.3 Gm.).

Tr. benzoïn. co. ʒj (30 c.c.).

M.

Inhale by drawing through the bent glass tubing and exhale through the nose. These inhalations should be practiced for 5 or 10 minutes every hour or two. The patient should remain indoors, unless the weather be warm, for at least 1 hour after each inhalation; provided, of course, that his local or general condition does not confine him to his home altogether.—[Hitschler.]

In the early stages of acute laryngitis, especially when the mucosa is dry, and indeed well into the period when secretion has become established, the following prescription, as recommended by Freeman, is most efficacious:

R *Apomorphinæ hy-*

drochloridi gr. ss-j
(0.032-0.065 Gm.).

Sodii citratis ʒiv-vi (16 to 24 Gm.).

Succi limonis,

Syrupi āā fʒvj (24 c.c.).

Aquæ, q. s. ad ... fʒiij (90 c.c.).

M. et Sig.: Two teaspoonfuls with water every 4 hours. Dispense in amber or blue bottle.

Relief is usually experienced within 12 hours.

The **inhalation of steam charged with the compound tincture of benzoïn** is preferred by some clinicians. It may be employed in the same manner as the tincture of guaiac. The addition of a teaspoonful of **paregoric** frequently assists the benzoïn in relieving the irritation.

In many cases the local disorder is greatly influenced by general disorders. In female professionals, especially, constipation is almost the rule, owing probably to their irregular mode of living, their varying diet, and the continued traveling in railroad cars. Purgatives, even mild aperients, are, for obvious reasons, out of the question when evening after evening the sufferer is to appear upon the stage. **Enemata**, while immediately effective, present the advantage of not diminishing the patient's strength. An enema composed of 1 pint of **lukewarm water** and a tablespoonful of **glycerin** will sometimes be found to act surprisingly, not only on the intestines, but on the voice, especially if, as is often the case with traveling artists, the bowels have not been moved for several days. If fever is present, drop doses hourly of **tincture of aconite** will usually reduce it markedly. If the inflammatory process is in the early stages and the patient's occupation demands the continued use of the voice, Kyle advocates the administration every hour for 3 or 4 doses of a tablet containing:

℞ *Acidi nitrici diluti*,
Tincturæ opii de-
odoratiāā mīij (0.18 c.c.).
Cocainæ phenatis gr. $\frac{1}{10}$ (0.006 Gm.).

In cases in which the bromides and opium cannot be given a solution of **resorcinol** or **alumnol**, 7 grains to the ounce (0.45 Gm. to 30 c.c.), should be used with an atomizer about every two hours the first day, then three times daily. To enable the solution to thoroughly bathe the bands, the voice should be sounded during inhalation, while the fluid is being sprayed in, the bands being thus

brought in and forming a floor, as it were, at the lowest portion of the larynx. When the hoarseness is great, an application with cotton pledget of **carbolyzed iodotannin** or a solution of **ferric chloride**, 20 grains (1.3 Gm.) to the ounce (30 c.c.), causes a sudden contraction of the capillaries, which is effectively maintained by the resorcinol solution.

To hasten the process of resolution, a pill composed of 1 grain (0.065 Gm.) of **quinine** and $\frac{1}{4}$ grain (0.016 Gm.) of **nux vomica** may be administered every two hours the first day, then four times a day. **Suprarenal gland**, 2 grains (0.13 Gm.), with **strychnin**, $\frac{1}{60}$ grain (1 milligr.), in a capsule taken after meals is also very helpful.

In the treatment of rheumatic disorders of the larynx local measures are practically useless. **Sodium benzoate** is sometimes quite effectual, 5 grains (0.3 Gm.) being given every three hours. **Sodium salicylate** is the standard remedy when it can be tolerated. (See RHEUMATISM.)

In acute laryngitis, strong astringents, e.g., tannin and cubeb, are not well tolerated. They are too irritating. Chlorate of potash is soothing. The following formulæ are suggestions:

℞ *Phenolis cryst.* gr. j (0.065 Gm.).
Potass. chlorat. gr. x (0.6 Gm.).
Glycerini ʒj (4 c.c.).
Aq. q. s. ad ʒj (30 c.c.)

M. To be sprayed into larynx *ad libitum*.

The physician may also use a spray of:

℞ *Cocainæ hydrochlo-*
ridi gr. j (0.065 Gm.).
Antipyrinæ gr. x (0.6 Gm.).
Glycerini ʒj (4 c.c.).
Aq. q. s. ad ʒj (30 c.c.).

M.

Sprays of argyrol or silvol, 10 to 20 per cent., are very soothing and non-irritating. Solutions stronger than this are apt to

clog the atomizer. Finishing the local treatment with a spray of:

R *Mentholis*,

Camphoræāā gr. ss. (0.032 Gm.).

Petrolati liq. ʒj (30 c.c.).

Ol. anisi gtt. j (0.06 c.c.).

is of service.—[Hitschler.]

EDEMA OF THE LARYNX.

Edematous infiltration of the larynx may occur as the result of a simple catarrhal process, of traumatic laryngitis, or as a complication of infectious disorders, proximate or remote.

SYMPTOMS.—The first manifestation may be a chill, soon followed by hoarseness and laryngeal pain. The most prominent symptom experienced almost from the start is a sensation of constriction at the throat and gradually increasing dyspnea, most marked during inspiration. There is also local heat, dryness, and a muffled cough, which the patient aggravates by efforts to rid the surfaces of a supposed secretion. There is increasing huskiness, both inspiration and expiration being finally impeded. In favorable cases there is a gradual decline of all symptoms; but this course is not always observed, and, unless prompt relief is afforded, the patient dies of asphyxia. The temperature is not, as a rule, much above the normal.

The laryngoscopical examination reveals local changes varying with the cause of the edema. When the latter is secondary to acute laryngitis the upper portion of the larynx over which the tissues are comparatively loose is swelled and red or reddish yellow. The epiglottis sometimes appears as a thick cushion, covering two sausage-like bodies under it, the aryepiglottic folds. As the tissues swell, these tend to roll inward,

forming a series of cushions, whose edges gradually approach one another, steadily reducing the lumen of the laryngeal cavity. When the edema is the result of traumatism or contact with corrosive acids, etc., there is great redness and supplemental local lesions. Marked inflammatory swelling also attends the crysipelatous form.

When edema is due to a general disorder, the mucous membrane is, as a rule, paler than when it occurs as a complication of a local inflammatory process.

In edema occurring as a result of the inhalation of steam, fire, caustic vapors, or due to the deglutition of too hot liquids, or of corrosive substances taken accidentally or with suicidal intent, such as carbolic acid, sulphuric acid, etc., the onset of the symptoms is comparatively sudden. Dyspnea and spasm sometimes occur from the start, and all the symptoms of acute laryngitis enumerated are increased in intensity. The gravest local manifestation of laryngeal inflammation, edema, is soon reached. In the majority of cases met with, however, after a series of acute manifestations, momentary dyspnea and laryngeal spasm, etc., which the physician does not, as a rule, witness, the larynx assumes a comparatively normal condition, as far as the patient goes, though, however, the laryngeal structures become infiltrated and after a few hours—sometimes an entire day—the most distressing symptoms appear, and the patient dies asphyxiated, unless relieved. (See colored plate.)

The upper portion of the larynx may show evidence of tissue destruction when such agents as carbolic acid, ammonia, etc., have been used;

but in the majority of cases laryngoscopic examination only reveals intense redness of all the laryngeal tissues, with slight swelling. The active congestion may be localized, this depending upon the causative agency. In laryngitis due to burning fluids the epiglottis may alone be involved, but in the vast majority of cases neighboring pharyngeal tissues, the interarytenoid space, the ventricular bands, and the vocal bands take part in the inflammation.

ETIOLOGY AND PATHOLOGY.

—The edema occurring as a result of simple catarrhal laryngitis is usually brought on by undue exposure to damp, cold air while the body is overheated by exercise, such as dancing, fencing, etc. *Décolleté* gowns, sitting at open windows after dancing, and drinking ice-water, have caused many deaths—credited to heart disease.

Edema of the larynx has also been observed in cases treated with potassium iodide. (See IODINE AND IODIDES).

It is probable that a latent disorder of the larynx is present in such cases. This may have existed before the use of the iodide or occur as a result of the disease—syphilis, for instance—for which the drug has been administered. Lesions of the kidney may mechanically induce laryngeal edema by interfering with the free elimination of fluids, while valvular heart disease may also predispose to it.

Many of the cases of edema of the larynx are thought to be of infectious origin, exposure of the parts to weakening influences of cold, etc., facilitating the entrance of micro-organisms of neighboring inflammatory processes, particularly of the nasopharynx. The base of the tongue, the mouth, and the tonsils are known to

be sources of infection. Inflammatory disorders of the glands of the neck, parotitis, tonsillitis, Ludwig's angina, etc., may thus suddenly be complicated with edema of the larynx and its dangers.

• Burning or scalding of the larynx, traumatism,—such as those induced by the passage of foreign bodies, sharp bones, tacks, inspiration of irritating fluids, or foreign bodies in the esophagus and lodged directly behind the larynx,—etc., may, as stated, also act as etiological factors. Acute thyroiditis at times produces an alarming edema of the glottis, but here a high leucocyte count will be significant, and the condition must not be mistaken for the presence of pus, when prompt surgical interference is required. Even alcohol has been known to produce localized edema. The occurrence of edema of the larynx in any case is in consequence of some structural alteration involving the local venous circulation.

Records of autopsies made under Virchow gave the following results:

In 3887 examinations edema of the larynx was noted 210 times,—149 in men, 40 in women, and 21 in children. Forty-four cases had occurred in regional disease and 166 in systemic disease. Of 5161 patients treated in the clinic for diseases of the throat and nose, between April 1, 1887, and June 1, 1889, there were only 8 with acute edema of the larynx,—7 in men between 21 and 48 years of age and 1 in a woman 58 years of age.

PROGNOSIS.—Edema of the larynx is at times so rapidly fatal that no warning of the oncoming issue is afforded. A patient suffering from slight hoarseness on retiring may thus be found dead next morning. Though

such cases are comparatively rare, they nevertheless show the importance of promptly attending to acute laryngeal maladies. When the iodides are being administered in connection with throat disorders, the larynx should be frequently examined laryngoscopically.

Cases in which the infiltration is localized are obviously less likely to prove mortal than those involving all the tissues. The latter form is that most frequently met with when general disorders—such as scarlet fever, typhoid fever, variola, etc.—act as the primary factor.

TREATMENT.—When edema is present vigorous measures should be adopted when dyspnea becomes evident. Until then, **cracked ice** should be kept in the mouth and **cold-water compresses** applied around the throat. Free **catharsis** with a saline should be early instituted. The patient should be well covered and given a **hot mustard foot-bath**, then immediately placed in bed, but in the sitting posture, and wrapped in blankets—the object being to cause normal diaphoresis. If this cannot be obtained normally, **pilocarpine** should be given hypodermically, or internally if the local manifestations are not marked.

The **bromides** are useful in reducing the local infiltration, and a dose of 20 grains (1.3 Gm.), for an adult, repeated as often as needed, sometimes proves very efficacious.

Tincture of belladonna, 5 drops every hour until its physiological effects become marked, also tends to counteract the infiltration by contracting the laryngeal blood-vessels.

Astringent solutions should only be used in circumscribed edema, a weak solution of **tannin**, **alumnol**, or

resorcinol being valuable in such cases. When the cases can be closely watched, a 10 per cent. solution of **cocaine** applied directly to the larynx causes momentary—though slight—retraction of the tissues, and may thus be advantageously used, especially when surgical measures are to be resorted to: scarification, intubation, or tracheotomy. In some cases, however, it seems to increase the dyspnea.

When the dyspnea becomes urgent, **scarification** of the laryngeal tumefaction is indicated. With the assistance of the laryngeal mirror—held in the left hand—the procedure is quite easy after anesthetizing the laryngeal tissues with a 10 per cent. solution of cocaine. The pocket-case curved bistoury is wrapped in a piece of bandage held in place with thread up to within $\frac{1}{8}$ inch of the tip, to prevent cutting the tongue with edge of the blade. The tongue being drawn out and held by the patient, the epiglottis will generally be seen standing erect, and looking, when much infiltration exists, not unlike a pale cherry. This should not be punctured first, as the patient may refuse a second incision and the first should be the most profitable one to him. The portion playing the most important part in the production of the dyspnea is the aryepiglottic fold, and this can usually be depleted by means of a short incision into its external border, thus causing the blood and serum to flow into the pyriform sinus, instead of into the larynx proper. When the patient is docile, both sides can be scarified and the epiglottis also, care being taken to prick the edges with the point rather than the internal aspect of the laryngeal walls.

When a laryngoscopic mirror is not at hand, the index finger of the left hand should be passed behind the epiglottis and used as guide for the curved bistoury.

At times scarification, even when thoroughly carried out, does not relieve the dyspnea. In that case the lower portion of the larynx and the tissues beneath the vocal bands will probably be found involved in the inflammatory process, when examined laryngoscopically—if seen at all. Under these circumstances either **intubation** or **tracheotomy** must be resorted to. (See INTUBATION and TRACHEOTOMY.)

When laryngitis is due to traumatism and the manifestations are not sufficiently marked to require operative measures, considerable pain is sometimes present; again, the lesion is so exposed that infection may occur, a benign process thus being transformed into a severe one. The most satisfactory results are to be obtained by strict cleanliness through the use of a 5-grain (0.3 Gm.) solution of **borax** applied with the atomizer, the laryngoscopical mirror being employed to properly locate the spray. Two grains (0.13 Gm.) of pure **iodoform** are then applied with the insufflator. This reduces the pain and curtails the infectious process in any form of laryngitis in which these elements prevail.

SYMPTOMATIC LARYNGITIS.

This term is sometimes applied to the laryngeal manifestations occurring in the course of general diseases, and involving, as a rule, the deeper structures. The symptoms vary with the intensity of the local manifestations, and may range from those of a simple laryngeal catarrh to the most

severe edema calling for immediate tracheotomy. Complications of so dangerous a nature are fortunately rarely witnessed.

Measles is usually attended by inflammatory involvement of the larynx. There is hoarseness and sometimes loss of voice, the symptoms, in fact, being quite those of acute laryngitis, including occasionally slight tumefaction.

The laryngoscope reveals a condition similar to that of the skin, the exanthem showing itself more or less clearly. Red spots project from the surface, giving it an irregular appearance. The process of resolution usually progresses without complication. Occasionally, however, edema or ulceration occurs as a complication.

Variola and Varicella.—The laryngeal manifestations of variola are various. In some cases small pustules are observed; these may gradually develop into a necrotic process, leading to perichondritis and even edema. The symptoms are those of acute laryngitis. The intensity of the local disorders varies with the gravity of the general disease, but, as a rule, the course is a benign one.

In varicella laryngeal symptoms are not as frequently observed as in variola, but they sometimes assume as serious proportions. Deglutition, phonation, and respiration may be seriously impaired, the latter resulting mainly from the smallness of the larynx in children.

Scarlet Fever.—In this disorder more or less marked involvement of the larynx is frequent. In the vast majority of cases, however, the cause of the trouble is benign, and resolution occurs along with the general malady. The exceptions inferred may at least

simulate various grave disorders, such as diphtheria and membranous laryngitis. Edematous infiltration is also occasionally witnessed, and likewise constitutes a grave complication. In all these disorders the tendency to ulceration is markedly increased, and, when this starts, it is checked with difficulty. Perichondritis and hemorrhage owing to destruction of blood-vessels are always to be feared in such cases.

Erysipelas.—There is a form of acute laryngitis closely associated with, if not an actual manifestation of, *erysipelas* of the larynx. This is a dangerous form, and may range from a simple redness to gangrenous changes of the structures. It is often accompanied by edema, high fever, great hoarseness, and dyspnea almost from the start.

Typhoid Fever.—The laryngeal complications of typhoid are to a certain degree typical in the fact that they are circumscribed in the great majority of cases. The parts that most frequently show erosions are the laryngeal surface of the epiglottis near the edge, the ventricular bands, and the upper part of the arytenoid space, the specific character of the complication being thus readily shown. The various ulcerative processes noted in scarlet fever are also occasionally observed in typhoid fever, the tendency to spread being equally marked. The destructive process may not only present itself during the progress of the general affection, but at some time after.

Pertussis.—In whooping-cough the laryngeal manifestations are sometimes quite marked, but they are not attended, as in other diseases, by ulcerative processes. The severe

cough induced occasionally causes marked congestion of the interarytenoid space, accompanied, at times, by extravasation and localized hemorrhage. Slight edema is frequently observed. Diphtheria as a complication has been witnessed, though very rarely. The most annoying feature in connection with the larynx is a resulting hyperesthesia of the interarytenoid space, which may persist indefinitely, the patient being subject to exacerbations of coughing when using his larynx any length of time. A dry, warm, or dusty atmosphere is also likely to cause considerable inconvenience. This sequel is especially apt to occur in adults.

Influenza.—The laryngeal complications of influenza generally occur in the cases in which symptoms affecting the upper respiratory tract are observed. There is the tendency to hemorrhage; ulceration is also occasionally observed. Spasmodic cough is also present, causing considerable distress to the patient by greatly increasing the intensity of the frontal cephalalgia. Edema of the larynx is occasionally met with, but, as a rule, it does not assume grave proportions.

Typhus Fever.—In this disease the manifestations are similar to those in typhoid fever and the complications are also liability to ulceration, edema, or pseudodiphtheria.

Schech includes under the name of **laryngitis exudativa** a series of affections of the laryngeal mucous membrane in which there is exudation with more or less fluid contained in vesicles or bullæ, or hyperemia with swelling. In **miliaria** there are vesicles on the epiglottis and aryepiglottic folds, giving rise to the sensation of a foreign body. **Herpes** very sel-

dom occurs alone in the larynx; there is usually an implication of skin or of mucous membrane. The vesicles rupture so quickly that they are seldom seen in the first stage, but are usually observed as erosions or small ulcers following the rupture. The contents of the vesicles may be serous, purulent, or even hemorrhagic.

Hoarseness, dysphagia, and pain on swallowing are usually the attendant symptoms, but sometimes nothing but a sensation of soreness is noted.

Schech also groups under the same head **foot-and-mouth disease** (stomatitis epidemica) accompanied by more or less constitutional disturbance and by vesicles in the larynx, which break down into ulcers; **aphthæ**, which sometimes occur in the larynx in association with aphthæ of the mouth or vulva; **pemphigus**, which occasionally forms exudative swellings in the larynx, but the disease is rare in this organ. **Urticaria** also occasionally affects the laryngeal mucous membrane, and the symptoms depend upon its extent. **Lichen ruber planus** is more usually observed in the mouth and fauces than in the larynx. **Impetigo herpetiformis**, **erythema nodosum**, and **erythema multiforme** are rarely observed in the larynx.

Involvement of the larynx occurs in all cases of **leprosy**, though it may be late in the disease. Following the symptoms of a simple catarrh, diffuse or circumscribed infiltrations occur, which mostly affect the epiglottis, changing its contour so that it may assume the shape of an omega, Ω . The infiltrations break down and various sized ulcers result. The tissues are destroyed, or white, glistening scars are formed, which

tend to the development of adhesions and stenosis. Although an anesthetic condition of the mucous membrane develops, there is a sensation of burning and tickling in the throat, which may even cause attacks of coughing. Dyspnea may become a prominent symptom.

PATHOLOGY.—Symptomatic laryngitis is ascribed to the penetration into the laryngeal tissue of micro-organisms, especially *Streptococcus pyogenes*, *Staphylococcus*, *Pneumococcus*, and *Bacillus coli communis*. The germs are thought to penetrate the deeper structures through minute abrasions of the surface or by way of the lymph-channels, the blood, etc. Neighboring inflammatory foci are especially prone to cause infectious disorders of the larynx.

TREATMENT.—The treatment of symptomatic laryngitis does not differ from that of acute laryngitis or edema of the larynx when the local manifestations are such as to warrant assimilation with these disorders. As a rule, the laryngeal manifestations of infectious diseases are slight, but the possibility of complications in this direction should always be borne in mind, owing to the rapidity with which they may prove fatal when untreated.

CHRONIC LARYNGITIS.

SYMPTOMS.—As a result of frequently repeated attacks of acute laryngitis, or of continued exposure of the larynx to conditions capable of maintaining a prolonged hyperemia of the larynx, a chronic catarrhal process is developed. Exacerbations of hoarseness, a sensation of rawness and heat, and the presence in the laryngeal cavity of secretions—mucoid or mucopurulent—giving rise to

a constant desire to "hem" constitute the main symptoms of this condition.

Chronic laryngitis is most frequently met with in singers. Hoarseness in these represents the most important symptom; it may be continuous or occur only after a few bars have been sung. This is usually accompanied by a feeling of local fatigue, heat, and constriction. The voice is usually lowered in pitch and may be veiled, muffled, or complete aphonia may exist. Pain is sometimes complained of. Cough provoked by sensation of itching or pricking frequently occurs as a prominent symptom. Slight hemorrhage and bloody expectoration are occasionally noted.

In some cases these symptoms present themselves upon the least exposure, disappearing after a few days. As the attacks are repeated, however, they become more resistant to therapeutic measures, and the local disorder becomes permanent symptomatically as well as pathologically. Hoarseness is then continuous. Warm weather, however, is apt to bring temporary relief.

The laryngoscopical appearances vary considerably, and are proportionate to the degree of active inflammation. The evidences of local hyperemia are nevertheless always present, and vary from a slight arborescent and light-pink tinge suggestive of congestion to a bright-red hue indicative of violent inflammation. The epiglottis is also congested, enlarged vessels coming over its posterior surface, while the arytenoepiglottic folds appear thickened, the tumefaction involving the entire larynx in marked cases. The surface is irregular and sometimes quite bosselated. The general red-

ness is not so marked as in some cases of acute laryngitis; it is apt to assume a brownish or violet coloration. The vocal bands are also more or less congested; the congestion may either be limited to a small portion of their surface or involve their entire area. Small masses of stringy, cream-like mucus are often to be seen, forming films, when the glottis is opened.

Sometimes the vocal bands appear relaxed and their thickened edges do not seem to come accurately together, an elliptical opening being occasionally observed between them. This want of parallelism is due to muscular inadequacy sometimes affecting but one side.

Shallow abrasions of the epithelial covering are occasionally met with, especially in the interarytenoid space. Deeper ulcerations, sometimes leading to perichondritis, have been observed by various clinicians.

The secretions are sometimes very copious, especially when, in the latter part of an active exacerbation of vocal disability, the patient tries to use his voice. This condition is termed *laryngorrhea* by some authors.

The terms *dry laryngitis* and *laryngeal ozena* have been given to a condition occasionally met with in which the secretion, besides being mucopurulent, is prone to adhere firmly to the mucous surfaces and to become partly desiccated in this situation. The dry crusts formed, by impeding the free passage of air, give rise to more or less dyspnea, while the breath is rendered fetid. Laryngoscopically examined, the larynx appears red and dry, with greenish crusts closely adhering to parts adjoining the vocal cords either above or below.

ETIOLOGY.—In singers, officers, hucksters, etc., who are called upon to use the voice excessively, chronic laryngitis may occur as a primary affection, but in persons who do not use their vocal organs professionally, the primary cause can usually be traced to some disorder of the adjoining cavities, nasal, nasopharyngeal, and pharyngeal. A dusty or smoky atmosphere may induce chronic laryngitis, but the other portions of the upper respiratory tract are involved in the inflammatory process.

The rheumatic and gouty diathesis, gastric and hepatic disorders, the abuse of alcoholic beverages, and all the factors enumerated under the heading of ACUTE CATARRHAL LARYNGITIS may act as causative factors when exposure to them is prolonged.

Dry laryngitis has been ascribed to many affections. In some cases it is but a manifestation of a general atrophic process involving the mucous membrane of the upper respiratory tract and may thus be identified through the presence of Löwenberg's bacillus.

In the very few cases that I have met with, dry laryngitis, when not accounted for by a nasopharyngeal affection or syphilis, was found associated with a gouty diathesis. The infraglottic space seems to be the favored region for the formation of the greenish crusts observed in this condition.

Chronic inflammatory disorders of the larynx are more frequently observed in men than in women, doubtless because the former are more exposed to the etiological factors outlined than the latter. Smoking and drinking are prolific indirect causes, as stated, and these habits are most

generally indulged in by the male sex. Chronic laryngitis can occur at all ages.

PATHOLOGY.—Dilatation of the blood-vessels through paresis of the vasomotors, interstitial infiltration which may lead to hypertrophy and thickening, are the main pathological features attending a case of uncomplicated chronic pharyngitis. The superficial vessels tend to become varicose, tortuous veins being observed, especially in regions—such as the ventricular bands, the interarytenoid membrane, etc.—where the tissues are lax. The glandular elements take an unusually active part in the inflammatory process of some cases, constituting what has been termed a *glandular laryngitis*. Rounded sessile projections, differing but slightly from the neighboring tissues in color, have been called *chorditis tuberosa* or *trachoma of the larynx*, but these are probably but mere localized hypertrophies, strictly associated with chronic laryngitis. *Chorditis nodosa* (singers' nodes) is a circumscribed hyperplasia of the epithelial and the subepithelial layers, and is situated on the edge of one or both cords, usually at the junction of the middle and anterior thirds. *Pachydermia laryngis* is usually noticed near the posterior end and on the margins of the cords as a rounded, oval or irregular, wart-shaped projection of a grayish or grayish-white color, with a corresponding depression on the other cord. The tissues beneath the vocal bands often take part in the inflammatory process, producing hyperplastic enlargement of the subglottic tissue, which is known as *chorditis hypertrophica inferior*, or *chronic subglottic laryngitis*. *Chorditis hypertrophica superior*, or *prolapsus ventriculi Morgagni*, is a hy-

peritrophic catarrhal condition of the ventricular folds, involving also the upper surface of the vocal cords and tending to the formation of pads and polypi, which project into the larynx.

TREATMENT.—The association so frequently noticed of chronic inflammation of the nasopharynx and of the larynx renders it imperative always to examine the entire upper respiratory tract when continued hoarseness is complained of. This is further supported by the fact that cases are often met with in which no benefit whatever is derived from treatment limited to the larynx until attention is given to the nasopharyngeal surfaces. **Cleanliness** of these parts, in fact, may be considered a *sine qua non* of success in 90 per cent. of cases. The same remarks may be applied in connection with concomitant disorders of other organs.

In many cases the laryngeal inflammatory process is sustained by disorders of the gastric, hepatic, and renal systems, all of which require close scrutiny.

Attacks of hoarseness in professional vocalists are often but exacerbations of chronic laryngitis, a deficiency of lubrication of the vocal bands being the main local factor. This condition may successfully be combated by the administration every two hours of 10 grains (0.65 Gm.) of **ammonium chloride** in a tumblerful of water, and the topical use of a **warm spray** of a saturated solution of **potassium chlorate** at the same intervals. The doses are so managed that the last one should be taken at least about three hours before a performance. This avoids exposure during the subsequent stage of perspiration. A lozenge containing 10 grains (0.65

Gm.) of **ammonium chloride** taken between the acts is of benefit in many instances.

In singers cocaine and the suprarenal preparations should not be applied in the larynx. They are goading spurs to a group of already tired nerves and muscles. Electricity and strychnine, except late in the treatment, are also contraindicated. It is on the simple astringents that the writer relies to check the catarrh and remove its effects, preferring **alum** and **zinc chloride**, the former in an atomized 2 or 3 per cent. solution, the latter in a 1 or 2 per cent. solution used as a spray or on an applicator, preferring the Burgess atomizer on account of its long, smooth tip and its finely divided spray. Grayson (Jour. Amer. Med. Assoc., Apr. 6, 1912).

In the treatment of diseases of the upper air passages in singers complete **rest**, with the use of **whispered-word method**, is indicated with inhalation of the following mixture:—

℞ *Tinctura benzoini*
composita ʒj (30 c.c.).
Olei pini ℥xv (1 c.c.).
Mentholis ʒss (2 Gm.).
Camphoræ gr. xv (1 Gm.).

Sig.: Add teaspoonful to 1 pint of warm water and inhale, t. i. d.

Singers do not stand severe measures well. The utmost gentleness should be used. Stivers (Calif. State Jour. of Med., Dec., 1912).

The characteristic congestion of this affection, and even the superficial erosions frequently encountered, will often yield to a **detergent spray** of **sodium bicarbonate**, **borate**, and **salicylate**, 3 grains (0.19 Gm.) of each to the ounce (30 c.c.) of water, applied copiously three times a day to the entire upper respiratory tract—the nose, the pharynx, and the larynx.

After cleansing, even the slight erosions should be touched with stronger agents. Solutions of **silver**

nitrate are most effective, but demand considerable dexterity if laryngeal spasm is to be avoided. The laryngeal forceps must be used, its tip, covered with a cotton pledget, being gently applied to the mucous membrane. **Resorcinol** is an effective agent in a solution containing 7 grains (0.45 Gm.) to the ounce (30 c.c.). A 20-grain (1.3 Gm.) solution of **iodoform** in **benzoinol** is a very effective remedy, but the difficulty of keeping the atomizer free when benzoinol is used renders its employment obnoxious to the patient. The infraglottic region should not be overlooked when local applications are made, the patient being directed to inhale deeply when the atomizer is being used.

Iodol might be substituted, but it possesses irritating properties when used in strong solutions; 5 grains (0.3 Gm.) to the ounce (30 c.c.) is the maximum strength that an inflamed larynx can stand with benefit. Solutions of **zinc sulphate**, **copper sulphate**, and **alum**, 5 grains (0.3 Gm.) to the ounce (30 c.c.), may be substituted should the other agents recommended not be obtainable.

Mild cases, especially those in which there exists involvement of the infraglottic tissues, are greatly benefited by **sodium benzoate**. Exacerbations are sometimes quickly stopped with 5-grain (0.3 Gm.) doses administered every three hours, in addition to the local measures recommended.

In certain cases the vocal bands will present, during an exacerbation of the catarrhal process, the greatest amount of congestion as compared with other parts of the laryngeal cavity. Their mucous membrane, as stated, appears thickened, bosselated, and very red at the edge, the voice

being coarse and screechy when an effort to sing is made. This form of chronic laryngitis is characterized by frequent exacerbations, and finally costs a singer his voice unless he stops singing for a while and undergoes active local treatment. Labus, of Milan, proposed flaying of the vocal bands in these cases, and obtained several satisfactory results. After thoroughly anesthetizing the larynx he tore off with a sharp square-tipped laryngeal forceps the superficial layer of membrane of the vocal bands—a procedure followed by slight hemorrhage, a few days' aphonia, and final recovery of the voice. Sajous has used for the same purpose fused **chromic acid** to destroy the thickened mucous layer, obtaining equally satisfactory results. **Cocaine** causing a copious flow of lubricating fluid from the lateral tissues when applied to the larynx for a certain length of time, it is necessary to use the acid as soon as possible after the application of the 25 per cent. solution.

The chromic acid, fused by heat to the end of a covered probe, such as MacCoy's, immediately before the anesthetic, is then applied to the surface of one of the vocal bands, while the patient, having been told to make a sound, brings both bands into apposition. This enables the operator to avoid cauterization of their edges—an important point in the preservation of the voice, especially in women. But little if any disturbance follows, and after a few days hardly a trace remains of the cauterization, except a spot presenting less redness than the surrounding parts. The applications should be made twice a week until all traces of localized congestion or bosselated areas have disappeared.

When laryngitis is aggravated by gastric, hepatic, or intestinal disorder, especially in drinkers and smokers, attention to these conditions should, of course, form an important part of the treatment. In patients who smoke considerably the congestion is often maintained simply by the irritating action of the air contaminated with smoke. Sitting in a smoking-car or in a room in which others are smoking is, therefore, as bad as if the patient himself were smoking.

In dry laryngitis attention to the nasopharyngeal disorder also forms an important part of the treatment. Detergent and disinfecting sprays are of great use, but must be employed for a considerable time. **Chlorate of potassium** in a saturated solution, and **potassium permanganate**, 3 grains (0.2 Gm.) to the ounce (30 c.c.), are effective agents, while **listerine** and water, equal parts, may also be recommended, to alternate with either. **Potassium iodide**, administered internally, 5 grains (0.3 Gm.) three times a day in half a glassful of water, tends to increase the laryngeal secretions, as it does those of the nasal cavities, especially in persons who are sensitive to its physiological effects. **Pachydermia laryngis** may be treated with **chromic** or **trichloroacetic acid**. When singers' nodes are large enough to cause discomfort, they may have to be **removed** with forceps. When a gouty or rheumatic diathesis can be traced, **colchicine** or **sodium salicylate** is indicated. (See GOUT and RHEUMATISM.)

TUBERCULOSIS OF THE LARYNX.

DEFINITION.—A tuberculous, primary or secondary, infiltration of the glandular elements and connective

tissue of the larynx characterized by tumefaction and ulceration and giving rise to dysphagia, aphonia, and dyspnea.

SYMPTOMS.—Tuberculosis of the larynx is often present in cases of pulmonary tuberculosis, and, were all the latter systematically examined laryngoscopically, lesions so situated as to preclude active subjective symptoms would be found in the majority of cases. Unless marked hoarseness, aphonia, or local pain be complained of, the larynx receives but little attention; were it otherwise, a greater degree of comfort could be afforded consumptives than they obtain when the pulmonary disorder is alone treated.

The larynx may become infected either through the lymphatics or directly through invasion of the laryngeal tissues proper by the bacillus of tuberculosis. Whether an erosion is necessary or not in the latter case is not established; it is believed, however, that such an erosion is necessary.

Slight hoarseness, short periods of aphonia,—a couple of seconds' duration at times,—a sensation of dryness, and local heat represent the early symptoms generally met with. If there is a pulmonary trouble, the symptoms of the latter, especially the cough, cause the laryngeal trouble to be attributed to it. After a period varying in length, the local pain is increased by deglutition, and sometimes radiates to the ears. The hoarseness is now apt to become aggravated or the voice may be completely lost.

The symptoms of early laryngeal tuberculosis are limited in number and not so valuable as the signs. The earliest is usually a mere weakening of the voice, which may appear long before hoarseness is noted.

C. L. Minor (Jour. Amer. Med. Assoc., Nov. 19, 1910).

Hyperplasia of a mammillated or other typical aspect, commencing at or near the subglottic portion of the base of the vocal process and gradually marked by a furrow in the vocal angle, is the most distinctive of the initial changes. Casselberry (Jour. Amer. Med. Assoc., Nov. 15, 1913).

In 8 of 10 cases of phthisis complicated by laryngitis, in which tubercle bacilli had been demonstrated in the sputum, the writer obtained a positive Wassermann reaction, the latter being then tested in a control series of 10 cases of pulmonary tuberculosis. An average of 10 per cent. had a positive Wassermann, as compared with the 80 per cent. in the laryngeal group. He concludes, therefore, that a syphilitic soil may act as a predisposing cause of laryngeal tuberculosis. Morton (Tubercle, Jan., 1921).

Cough is not severe, as a rule; but it is peculiar, being usually husky and lacking in resonance. The general health may continue to be good as far as active constitutional symptoms are concerned, until the distress during deglutition becomes such as to cause the patient to reduce the amount of food he takes to avoid the pain the act involves. Indeed, the dysphagia is such sometimes as to render the taking of any food a source of dread to the patient, and constitutes the most marked of all the symptoms. It is especially severe when the epiglottis is the seat of the tuberculous ulceration or when the pharynx is affected. In fatal cases it is apt to persist and to become steadily aggravated. The pulse, temperature, and other general symptoms are those of pulmonary phthisis, but emaciation progresses more rapidly than in the latter disease, the pain during the deglutition causing

the patient to abstain from food as much as possible.

Examination of the larynx during the early stages usually reveals a characteristic feature: a pale-yellowish tinge, which sometimes reaches to absolute pallor. In the majority of cases a typical sign also appears: a pyriform swelling, or "clubbing," of the arytenoids, which causes these prominences to resemble small cushions if they are both enlarged, which is not always the case. In some instances, however, the larynx may be as red as usual, and even appear congested. After a short time, grayish, superficial erosions may be detected, which, after a while, become deeper and sharp-edged, and are surrounded by a narrow, red areola. A thick, tenacious secretion usually collects over them, which can only be removed with difficulty. The morbid process then extends in various directions until almost any part of the larynx and neighboring tissue is involved in the general trouble. Various excrescences or tumors may appear, so situated, sometimes, as to compromise the laryngeal aperture. It will be seen, therefore, that the lesion may be in the form of an infiltration, an ulceration, or a tumor. Involvement of the larynx with miliary tubercles is questionable.

DIAGNOSIS.—The pallor of the mucous membrane, especially marked posteriorly; the club-shaped masses over the cartilages of Wrisberg and Santorini, and, in a large proportion of cases, the turban-like epiglottis give the larynx a characteristic appearance when the local process is at all active. The ulcers are more superficial than those of a syphilitic larynx, and appear grayish rather than yellow,

as in the latter disease. The syphilitic ulcer is "punched out," with perpendicular and crenated edges; the areola is dark in hue, and the ulcer is usually situated anteriorly, in contrast to tuberculosis, which occurs in the region of the arytenoid cartilages. The cancerous ulcer tends to be raised by underlying accumulation of morbid elements, and is totally devoid of the pallor peculiar to tuberculosis. The pain is usually most acute during deglutition in tuberculosis, during phonation in syphilis, and constant in cancer. Early paralysis has appeared as a comparatively frequent phenomenon, manifesting itself even before any laryngeal changes are evident. The injection of tuberculin may aid in the diagnosis.

PROGNOSIS.—Spontaneous cure of the slight tubercular ulcers occasionally occurs (14 cases out of 3000, Heryng), but the normal tendency of a tubercular process in the larynx is toward aggravation. When the epiglottis is affected the chances of recovery are very slight. These are improved materially, however, if the patient can be removed to a mild and warm climate and when the general health can, by suitable dietetic means, out-of-door life, and the judicious use of creosote, be favorably influenced.

After-histories of 833 tuberculous patients discharged from the sanitarium 3 to 7 years. Of those with no laryngeal tuberculosis about 16 per cent. in the first stage died; 38 per cent. in the second stage died; and slightly over 70 per cent. of those in the third stage died; or for all the cases the mortality was just under 40 per cent. Of those with tuberculous involvement of the larynx, 43 per cent. in the first stage died; 63 per cent. in the second stage; slightly over 78 per cent. in the third stage

died; and for all combined the mortality was 70 per cent. The prognosis was uninfluenced by laryngeal involvement in third stage cases, but it was $2\frac{1}{2}$ times less favorable in the first stage when the larynx was involved than when not. St. Clair Thomson (Lancet, Oct. 18, 1919).

TREATMENT.—The treatment of tuberculosis of the larynx should be local and general. The indications for the general measures will be thoroughly reviewed in the article on TUBERCULOSIS, PULMONARY, and are *invariably* applicable when the larynx is diseased, whether primarily or secondarily.

Thorough **cleansing** of the laryngeal surfaces is an important feature of the treatment. This can be done most satisfactorily with a lukewarm solution of **sodium borate** and **bicarbonate**, 10 grains (0.65 Gm.) of each to the ounce (30 c.c.) of water, using an atomizer, or the familiar **Dobell's solution**. Care should be taken to relieve the surfaces of all purulent discharges, and thus prepare them for remedial agents. If this cannot be done daily by the attending physician, some person in the immediate surroundings of the patient should be carefully instructed; but under such circumstances the cleansing process had better be resorted to night and morning.

As a local application Elsberg's saturated solution of **iodoform in ether** has stood the test of time; it must be applied with the laryngeal forceps, a cotton wad being used. For the patient's home use, a solution of **menthol**, 20 grains (1.3 Gm.) to the ounce (30 c.c.) of **benzoinol**,—an excellent agent for the purpose,—will not only relieve the suffering, but greatly assist the curative process.

The writer has been experimenting on the principle of generating a powerful antiseptic substance by the chemical union within the tissues of two substances introduced by different routes—one brought to the tissues by the blood, the other with inhaled air or otherwise. A chemical reaction results on and in the tissues. The combination of sodium or potassium iodide for the blood-brought element and ozone for the inhaled gaseous element answers the purpose admirably. The chemical union resulting liberates iodine in nascent form. This seems to possess remarkable curative efficacy in localized infectious processes, particularly in tuberculous or syphilitic laryngitis. He begins with 3 Gm. (45 grains) of **potassium iodide** daily, fractioned, and applied continuously the **ozone** or **hydrogen peroxide** in a 2 or 3 per cent. solution, acidified with 1 per cent. acid. Pfannenstill (Hygeia, May, 1910).

Yeo's continuous respirator will check cough in laryngeal tuberculosis. The preparation generally used is as follows:—

R *Creosote* ʒij (12).

Spirit of chloroform,

Oil of pinus sylvestris, of each ʒiiss (6).

Oil of cinnamon,

Oil of citronella,
of each mʒ (0.3).

Menthol gr. v-x (0.3-0.6).

Dundas Grant (Pract., Mar., 1912).

Locally, the writer has derived the best results in these cases from a fresh 3 to 5 per cent. solution of **formalin**. The larynx should be first cleansed with an alkaline solution, and then a cotton swab saturated with the formalin rubbed over the surface. The burning sensation following is not especially painful except in the most advanced cases and may be prevented by applying **cocaine** beforehand. The throat feels clearer, and in many cases the cough is eased by this treatment. G. H. McFall

(Jour. Mich. State Med. Soc., July, 1912).

The writer, utilizing the necrosing action and slow cauterization of neutral **quinine hydrochlorate**, employed this drug in a typical case of vegetant tuberculous laryngitis, and obtained transformation of this lesion into an infiltrated ulceration of good aspect, much more apt to succumb to the successful action of the usual remedies. Genestro (Annales des mal. de l'oreille, du. lar., etc., Mar. 3, 1913).

More active measures are resorted to by specialists, and **lactic acid** may be said to hold a high position in this direction. A 50 per cent. solution, well rubbed into the ulcerated tissues after they have been thoroughly anesthetized with a 20 per cent. solution of **cocaine** every three days, is often productive of excellent results, but only in cases in which the local lesion is limited in extent.

Details of 80 patients cured out of 290 cases. It is a strict rule at the institution never to operate when the patient has fever, and this restriction is probably an important factor in the results attained. **Cauterizing (lactic acid)** is a far less serious procedure than mutilating operations; it gave 35.7 per cent. permanent cures among the 42 patients thus treated up to 1905, and 55.2 per cent. permanent cures in the 29 patients since that date. Brüll (Beitrag z. Klinik der Tuber., Bd. xxiii, Nu. 1, 1912).

The local application of lactic acid is greatly facilitated by the continued use of **orthoform** either in powder or, as advised by Kassel, in the form of an emulsion containing orthoform, 25 parts; olive oil, 100 parts. The burning sensation lasts only about a quarter of an hour, and is then succeeded by anesthesia, which commonly lasts from twenty-four hours to three and a half days. The patient is able to eat all kinds of food, and the

appetite is greatly increased. A distinct diminution in the amount of secretion in cases of ulceration is noted, but otherwise it does not appear to have any local therapeutic value. Patients do not dread the lactic acid treatment if orthoform emulsion is used regularly. In some cases, in order to control the cough, or at least reduce it to a minimum, it may be necessary to resort to sufficiently large doses of **heroin** or **codeine**. The use of **tuberculin** may be found beneficial in incipient cases.

A review of the results of local treatment of a tuberculous larynx with **tuberculin** shows them to be very conflicting, but early cases of phthisis of the larynx will yield to the tuberculin treatment. Hutter (Wiener klin. Woch., Feb. 22, 1912).

Exposure of the larynx to sunlight or **heliotherapy** and deep **X-ray** exposures have been recommended.

Sorgo in 1904 claimed to be successful with **sunlight** treatment of tuberculous laryngeal lesions. The writer reviews what nearly two dozen other writers have published on heliotherapy and the few experiences with it in Sweden, and then reports the history of 4 patients between 21 and 35 in his own sanatorium at Osterasen. His conclusions are that **heliotherapy** is a simple and harmless method of treatment, effectual when the weather conditions are favorable, and free from the slightest untoward by-effects. Tillman (Hygeia, Apr., 1909).

Case which confirms the effectual action of deep **Röntgen exposures** in treatment of laryngeal tuberculosis, as the writer has already demonstrated for tuberculosis of bones and joints. Wilms (Deut. med. Woch., Feb. 10, 1910).

Direct **sunlight** in the treatment of laryngeal tuberculosis has given very encouraging results. His first patient treated in this way in 1905 has been

permanently cured for over six years to date. This patient was a man of 33 without fever or much cough, but with relative dullness over the right apex. He wore a broad black hat and black spectacles and sat facing the sun, projecting on the larynx the sunlight received on the mirror of the laryngoscope placed in the throat, supervising the reflection of the rays with a hand-glass. He kept this up at intervals during the day, amounting to a total half an hour at first and later an hour daily. In six weeks the improvement was marked and by the end of seven months there was scarcely a trace of the laryngeal affection. In a second case two-hour exposures during the day were made with equally favorable outcome, and in a third case marked improvement was realized in a few weeks. Collet (Lyon Méd., Mar. 10, 1912).

The **curette** may be used to advantage when too much tissue is not involved in the tuberculous process. It should be limited, however, to primary and incipient cases, and to cases in which the pulmonary lesions are very limited in area. Under such circumstances the chances of success are quite fair. Unfortunately the procedure requires a degree of dexterity which an experienced specialist alone can possess, even with the assistance of a 20 per cent. solution of cocaine, which facilitates the operation and renders it comparatively painless. Heryng's or Krause's curette may be used, the operation being watched in the laryngoscopical mirror. Cicatrization is usually complete in three or four weeks, and considerable relief is afforded if cure is not obtained. The application of 50 per cent. **lactic acid** to the curetted spot serves to increase the efficiency of the treatment.

Among the more severe surgical measures at the disposal of the physician, **enucleation** of the diseased area

with sharp forceps may be advantageous when the infiltration is limited to a location, such as the arytenoid prominences, which may readily be grasped. **Thyrotomy** enables the surgeon to reach all parts of the larynx from the outside and to curette thoroughly any diseased surface. This should not be resorted to, however, when the disease is far advanced. The **galvanocautery** has recently been advocated to encourage cicatrization in cases of dense infiltrations and in those where the ulcers show a tendency to sluggishness. **Tracheotomy** is sometimes resorted to, to give complete rest to the larynx or when dyspnea becomes a source of suffering or threatens to become aggravated.

Four cases in which **tracheotomy** proved effectual in promoting the healing of a laryngeal tuberculous process. One patient is still wearing the cannula, three years since the operation. The processes in both larynx and lungs were healed or arrested. The results were equally favorable in three other cases, but another patient after local benefit is succumbing to his pulmonary process. The tracheotomy was borne without any essential reaction on the part of the lungs and the general health essentially improved as the larynx healed. Hinsberg (Med. Klinik, Apr. 19, 1908).

Amputation of the epiglottis in laryngeal tuberculosis is demanded in every case of involvement accompanied by severe dysphagia, regardless of the state of the lungs, even when dysphagia has not supervened, provided the lesion is extensive and there is still hope of arresting the pulmonic disease. Any lesion that resists treatment should be excised. If the condition of the epiglottis is such as to hinder correct treatment of underlying lesions, it may be removed to render these parts more accessible. L. B. Lockard (Annals

of Otol., Rhin., and Laryn., Dec., 1909).

The writer has succeeded in putting an end to the dysphagia in 2 cases, a woman of 33 and a man of 36, as a last resort by **resecting the superior laryngeal nerve**. The by-effects were slight and transient. Blumenthal (Berl. klin. Woch., Sept. 4, 1911).

Tuberculous laryngitis not only does not contraindicate therapeutic pneumothorax, but the latter has a marked beneficial influence on the throat affection. Among his 76 patients treated with the **compressive pneumothorax**, 12 had laryngeal tuberculosis of greater or less severity. The mild forms promptly healed without other measures. Under application of powders or **mentholated oil** and strict enforcement of the rule of **silence**, even the 4 severest cases healed completely. Zink (Münch. med. Woch., Sept. 2, 1913).

Over 1500 **resections** upon 575 cases of laryngeal tuberculosis showed that tuberculosis of the larynx is curable, the results showing complete cure in about 50 per cent. of those in the first stage, that is, with simple and circumscribed involvement; in 25 per cent. of cases of medium gravity, and in 13 per cent. of grave and rapidly progressing cases. Spontaneous cure may occur under proper conditions of **altitude** and **heliotherapy**, but improvement in the pulmonary condition cannot be shown to have any favorable effect on the laryngeal tuberculosis. Operative treatment should be undertaken only in cases without fever, in which the pulmonary condition is stationary, with the exception of when operative measures are urgently required for mere temporary symptomatic relief. Thomas Rüedi (Brit. Med. Jour., June 21, 1919).

An important feature of the treatment is to enable the patient to nourish himself properly. Unfortunately the dysphagia is always the most marked symptom, and the sufferings

of the patient are sometimes excruciating. One of the most satisfactory methods is to apply a 4 per cent. **cocaine** solution with the atomizer, about five minutes before each meal, to the larynx, thoroughly bathing all its surfaces, and to alternate this every week with **orthoform** powder. The patient does not, in this manner, become habituated to either drug, and the beneficial effects of each are preserved. Kyle has found that the use of the **juice of the pineapple**, applied by means of a spray or applicator, is frequently efficacious in relieving the distress to a certain extent. The **deep injection of alcohol** into the superior laryngeal nerve has many enthusiastic advocates. Recently a solution of **quinine and urea hydrochloride** has been used with success in cases of sciatica. It could undoubtedly be resorted to in severe cases of dysphagia and injected in the same way as alcohol, but so far no recorded cases have been seen in which this has been done.

To obtain **permanent anesthesia** in tuberculous laryngitis the writer used a simple apparatus with which the patient is able to insufflate, himself, the anesthetic powder and thus anesthetize the region before eating. It is an open cup on the end of a bent tube. The powder is placed in the cup, the other end of the tube introduced into the throat, and the powder inhaled through the tube. Hoffmann (*Münch. med. Woch.*, Apr. 7, 1908).

Injections of alcohol into superior laryngeal nerve effectually relieved severe dysphagia in 6 cases. Use Schlösser's needle, with point bluntly beveled. Patient horizontal. Make affected half of larynx project by pressing on sound side. With index finger find painful spot between thyroid cartilage and hyoid, pressing in from without. Push in needle for

1½ cm. at this spot, and move it about to seek spot where patient feels pain in ear. Inject slowly solution of 2 grains (0.13 Gm.) of **beta-eucaine hydrochloride** in an ounce of 80 per cent. alcohol, warmed to 45° C. (113° F.). Continue injection until pain in ear ceases. Patient not to swallow or speak during operation. Dundas Grant (*Lancet*, June 25, 1910).

Method for relief of pain by **injecting alcohol** into internal branch of superior laryngeal nerve described. Cleanse skin with alcohol. With left hand grasp larynx to steady it and hold it prominently under skin of side to be injected. Left index finger seeks the comparatively tender point where internal branch of superior laryngeal nerve penetrates thyrohyoid membrane, a point about halfway between upper border of thyroid cartilage and hyoid bone, and about 1 cm. in front of superior cornu of thyroid cartilage. Hold finger firmly in place while needle is inserted at center of nail perpendicularly to a depth of 1 to 1½ cm., causing, if nerve accurately located, pain radiating to ear. Then inject drop by drop ½ to 2 c.c. (8 to 32 minims) of 75 per cent. alcohol (with or without 1 per cent. cocaine), previously warmed, until original pain ceases, or 2 c.c. (32 minims) used. Repeat next day if necessary. Lewy (*Laryngoscope*, Jan., 1911).

For the treatment of difficulty and pain in swallowing, **injection of alcohol** around the nerve involved in the trouble seems to give the best results, while it is a very simple and apparently harmless procedure. By the technique advocated by Hoffman, 85 per cent. alcohol is injected around the superior laryngeal nerve, introducing the needle from the side of the neck, along the lateral thyrohyoid ligament. Boncour makes the injection on the median line between the body of the hyoid bone and the angle of the thyroid cartilage. Wetterstad followed the first technique in 6 cases and the second in 4, all

the patients suffering severely from their advanced laryngeal tuberculosis. Complete relief from pain followed the injection, the relief persisting for fifteen or thirty days or longer. The injection seems to be easier and freer from possible complications when made in the median line. Wetterstad (Jour. Amer. Med. Assoc., from Norsk Mag. f. Lægevidenskaben, Jan., 1914).

Much of the suffering may be avoided in the later stages if, as suggested by Wolfenden, the patient will **lie on his stomach** on a bed and suck up liquid food through a tube from a receptacle placed on the floor. The food thus tends to enter the esophagus through the pyriform sinuses on each side of the larynx, and to avoid contact with the latter. Occasionally **pressing the larynx forward**, away from the pharynx with the palms of the hands on the sides of the neck, will assist materially in deglutition.

In all cases of painful dysphagia the internal laryngeal nerve should be blocked. There are no contraindications to **nerve blocking**, and this procedure aids the dietetic treatment by removing or lessening dysphagia sufficiently to allow the patient to eat necessary food. More rest is obtained, due to cessation of pain from the throat, and any number of injections may be made and the patient kept in constant comfort by injecting as soon as the pain occurs. Lukens (N. Y. Med. Jour., Feb. 23, 1918).

SYPHILIS OF THE LARYNX.

This condition develops in the regular course of the disease contracted by impure intercourse, or it may be the result of the use of an infected instrument in the throat, although it is doubtful if the primary sore has ever been observed in the larynx.

SYMPTOMS.—The symptoms found are usually those of either the

secondary or tertiary stage. The erythema of the second period presents the signs of a simple catarrh, accompanied by more or less secretion, and produces a hoarse or raucous voice.

As the disease progresses, the small, round-celled infiltrations break down and result in the formation of superficial, clear-cut ulcers, best known as *mucous patches*, which are especially located on the margin of the epiglottitis, in the central and anterior portions of the vocal cords, and on the postlaryngeal wall. The subjective symptoms are insignificant and may manifest themselves only in disturbances of the voice, which may vary from a slight hoarseness to complete aphonia.

The tertiary stage of the disease shows more advanced infiltrations and deeper ulcerations, with pronounced edema. The ulceration is quite characteristic, exhibiting a sharply cut, deep, crater-like depression with indurated edges, and the floor of which is covered with a slimy secretion. Involvement of the cartilage by the ulceration produces a chondritis. As syphilitic cicatricial tissue shows a decided tendency to contract, pronounced disfigurement, stenosis, and distortion frequently result, and may produce irreparable functional disorders. Paralysis of the vocal cords is not infrequent, usually due either to the infiltration of the muscles or to the pressure of affected glands upon the recurrent laryngeal nerve.

DIAGNOSIS.—This is usually not difficult, but occasionally considerable care may have to be exercised in an effort to differentiate between syphilis and tuberculosis. The his-

tory and the examination, the less destructive process and the more pronounced subjective symptoms in the latter disease, the presence of spirocheta in one and of tubercle bacilli in the other, and the Wassermann test, which is now considered conclusive evidence of syphilis, will tend to dissipate the confusion. The task of differentiation becomes more difficult, however, if the two diseases coexist in the same patient.

TREATMENT.—This is usually constitutional, although local conditions may demand careful attention, especially if cartilaginous necrosis has taken place. The usual **antisyphilitic treatment** should be instituted. It may be found advantageous to alternate the administration of **salvarsan** with that of **mercury**.

Syphilis of the larynx seldom endangers the life of the patient. While the disease usually responds to appropriate treatment and the patient in time is relieved of symptoms, in extreme cases the contractions of the cicatricial tissue may be so great as to necessitate the performance of **tracheotomy**.

ABSCESS OF THE LARYNX.

This is found in tuberculous perichondritis, has been observed to follow erysipelas, and may also be of traumatic origin. The infecting bacteria gain entrance beneath the perichondrium and cause the formation of pus, which produces a tumor-like mass.

SYMPTOMS.—The symptoms are fever, pain as the result of the retention, loss of voice, and symptoms of suffocation, because of the encroaching of the abscess upon the glottis.

TREATMENT.—The part should be anesthetized with cotton dipped in

a 10 per cent. solution of **cocaine** and applied with Sajous's laryngeal forceps. An **incision** should then be made into the abscess with a curved laryngeal lancet and the pus evacuated. In extreme cases **tracheotomy** may have to be resorted to to prevent suffocation.

STENOSIS OF THE LARYNX.

This often follows high tracheotomy, or may result from morbid processes in the larynx or trachea, although extralaryngeal causes may occasionally lead to it. Aspiration of foreign bodies, injuries, diseases of the laryngeal walls, granulation and scars, nervous disorders, and pathological processes in neighboring organs are other possible sources leading to obstruction of the larynx.

SYMPTOMS.—The chief symptom is dyspnea. Of course, the narrower the lumen, the greater the danger of suffocation. Other manifestations, as well as the prognosis, depend upon the location and the cause of the stenosis.

TREATMENT.—When the lesion is acute and develops rapidly, a **tracheotomy** will bring relief and may even furnish a permanent cure, but if some constitutional disease is the primary cause in a slowly developing stenosis the relief from a tracheotomy will be only palliative. **Catheterization** of the larynx after the method of Schrötter may be found advantageous. **Intubation** under direct vision (see next article) offers the best prospects of cure. The main point in the treatment consists in preventing suffocation and determining and removing the cause.

When a laryngeal stenosis was the result of hyperplastic changes, some form of dilatation proved to be the

most logical method of overcoming it. Gradual, systematic **dilatation by intubation** offers very favorable prospects of success. The tube with a low retaining swell and a wide head seems to meet a want in the treatment of this form of stenosis. In children hypertrophic laryngitis is largely responsible for a chronic laryngeal stenosis. In this particular affection tracheotomy is more apt to induce connective-tissue changes than to effect a final cure. Homer Dupuy (*N. Y. Med. Jour.*, Apr. 5, 1913).

Intubation should not be prolonged much beyond a month in the treatment of laryngeal stenosis following diphtheria. A **low tracheotomy** should be performed. **Intermittent dilatation under direct vision** until the larynx reaches about normal size, and then only when stenosis develops. Tracheotomy affords rest to the larynx and gets rid of a foreign body. The danger of coughing up the laryngeal tube is eliminated. The treatment would seem to require a shorter period of time than that required for continued intubation with the hope of better results. D. L. Richardson (*Boston Med. and Surg. Jour.*, May 22, 1913).

CHONDRITIS AND PERICHONDRITIS OF THE LARYNX.

These two conditions are so closely allied in their course, symptoms, and treatment that it is unnecessary to consider them separately.

SYMPTOMS.—The **arytenoid cartilage** is the one most frequently affected, although the cricoid and thyroid may be involved separately or in conjunction with the arytenoid. The epiglottis appears to be the least affected. The objective symptoms produced will naturally depend upon the cartilage involved and the extent of the inflammation. Involvement of the arytenoid is more frequently on one side than bilateral. Edema in the

region of the arytenoid may be sufficient to extend along the aryepiglottic fold, or beyond the region of the vocal cord. Mobility of the cord is usually interfered with. If the cricoarytenoid joint is involved, ankylosis may result, with permanent alteration of the voice. When necrosis of the cartilage develops, the area may be visible and the discharge of pus detected, especially if gentle pressure is made on the outside.

The **cricoid cartilage** is not infrequently affected as the result of ulcers on the posterior laryngeal wall, especially in tuberculosis and typhoid fever. If the swelling involves the arytenoid region as well as the posterior wall, it is fair to assume that both the cricoid and arytenoid cartilages share in the inflammatory process. Pronounced swelling in the pharynx and pyriform sinus will indicate involvement of the external perichondrium of the cricoid, while disease of the anterior arch will produce a swelling in the anterior region of the neck which will be tender on palpation.

Involvement of the **thyroid cartilage** will show an external or an internal swelling, according to the location of the inflammation. The internal swelling is usually in the region of the anterior commissure.

The firm attachment of the perichondrium to the **epiglottis** makes difficult its separation by any pus formation. The cartilage, therefore, is more apt to be eroded and necrosed, especially by tuberculous and syphilitic ulceration.

Among the subjective symptoms, pain, hoarseness, and dyspnea may be present. A characteristic symptom may be noted in the radiation of the

pain to the ear on swallowing. This may be agonizing, especially if the arytenoid, cricoid, and epiglottis are simultaneously involved. External pressure over the affected area may sometimes produce considerable discomfort. The extent of the hoarseness will depend upon the amount of hindrance to the mobility of the cords. Dyspnea may be a pronounced symptom, owing to the extensive swelling of the laryngeal tissue. The rupture of an abscess into the larynx, the impaction of a necrosed piece of cartilage in the glottis, or the fixation of the vocal cords may produce alarming symptoms.

ETIOLOGY.—Syphilis and tuberculosis seem to be the most frequent causes of chondritis and perichondritis of the larynx, although many other infections have been held responsible. Actinomycosis, glanders, and various other contributory causes may also occasionally be noted. Some form of traumatism may very easily be the etiological factor. Only occasionally, viz., in pyemia, acute polyarthritis, etc., is a metastatic chondritis or perichondritis produced.

PATHOLOGY.—The infecting organism leads to a suppuration between the perichondrium and the cartilage. As the abscess develops, the perichondrium is separated from the underlying cartilage and bulges forward. The cartilage, being deprived of its blood supply, is prone to undergo necrosis. When the abscess ruptures, the necrotic cartilage can usually be detected projecting from the abscess cavity.

PROGNOSIS.—The many complications of a serious nature which may occur tend to make the prognosis a very serious one. Especially is this

true in tuberculosis and cancer, while a syphilitic lesion can offer very little more encouragement.

TREATMENT.—If possible, the cause should be determined and the treatment regulated accordingly. When the abscess develops, it should be evacuated, the **incision** being made with a guarded laryngeal knife. If the pointing is externally, as sometimes happens in the so-called external perichondritis, the evacuation of the pus should not be difficult. The respiration should be carefully watched and **tracheotomy** performed at the first evidence of excessive embarrassment. Resort to **narcotics** may be necessary to relieve the suffering. **Ice** internally and externally may give a certain degree of relief when the lesion is due to trauma.

Two cases of perichondritis of the thyroid cartilage manifesting itself as an exolaryngeal and endolaryngeal swelling. Both cases were secondary to tuberculous ulceration of the larynx and were treated by incision and drainage. In one of the cases cited extensive tuberculous granulations of the wound were treated with **radium** with moderate relief. Viktor Frühwald (Wiener klin. Woch., Jan. 15, 1914).

DISEASES OF THE LARYNGEAL JOINTS.

Inflammations of the joints of the larynx are probably more common than is usually realized, their apparent rarity resulting from the difficulty of properly interpreting the indefinite symptoms and from the lack of sufficient post-mortem investigation. Involvement of the laryngeal joints is not uncommon in cases of rheumatic or gonorrheal arthritis, while some of the infectious diseases, *e.g.*, typhoid fever, diphtheria, variola,

tuberculosis, and syphilis, may manifest symptoms indicative of extension to the parts. The cricoarytenoid joint is that usually affected. A serous or seropurulent exudate may appear; the periarticular tissue may or may not become infiltrated. The patient may be conscious of a feeling of tension during activity of the throat. The sensation may become aggravated on touching the sensitive spot with a probe or finger. A crackling noise produced by gentle pressure on the upper and back part of the thyroid cartilage is thought to be pathognomonic.

PARASITIC INVASION OF THE LARYNX.

Animal parasites seldom gain entrance to the larynx, although small insects may be inhaled during a strong inspiration. *Trichinæ* seem to show some preference for the laryngeal muscle in which to encapsulate, and *ascarides* have been known to crawl into the larynx.

Vegetable parasites are also found in the larynx, though very infrequently. **Thrush** has been observed to extend from the pharynx. The presence of *leptothrix* has been described. From reported cases, **actinomycosis** has been found as a secondary lesion, but Arrowsmith has recorded one in which there was apparently a primary laryngeal infection (Laryngoscope, Oct., 1910, p. 977).

SCLEROMA OF THE LARYNX.

This is a rare disease in this country, but it is frequently encountered in certain parts of Europe. It is very seldom primary, but usually occurs as a continuation of the same disease in the nose and pharynx. The scleroma

bacillus is thought to be responsible. An inflammatory infiltration manifests itself below the vocal cords and presents a typical picture of hypertrophic subglottic laryngitis. Extension may occur along the trachea, and even into the bronchi, but more frequently the disease spreads to and involves the ventricular folds, the arytenoid cartilages, the aryepiglottic folds, and the epiglottis. The development of pad-shaped or even smaller nodular infiltrations of a pinkish or bright-red color and of hard consistency is noted.

SYMPTOMS.—These are usually of a catarrhal nature. The formation of scabs and crusts may give rise to the offensive odor characteristic of ozena. The diagnostic features of the disease are its coexistence within the nose, throat, and larynx, its exceedingly slow and painless progress, the peculiar odor of the scabs, the conspicuous pale infiltrations, and the absence of ulceration.

TREATMENT.—This is largely symptomatic. The condition may be influenced by the use of the **Röntgen rays** or of **radium**. Less conservative measures may become necessary if stenosis develops to any extent.

FOREIGN BODIES IN THE LARYNX.

The foreign bodies that may become engaged in the larynx may be said to represent almost anything that may be introduced into the mouth. A large mass of meat totally beyond the dimensions of the cavity may dip one of its extremities into the latter, and cause fatal dyspnea by acting as a stopper, or it may become jammed between the pharyngeal wall and the end of the epiglottis, and thus also

cause immediate asphyxia. Tooth-plates, among the larger objects, are also frequent intruders in this region. Those which most frequently become lodged there, however, are principally articles of diet,—bones, bread-crusts, fish-bones, etc.,—which are drawn into the air passages during a fit of laughter, just as the act of deglutition is being performed. Their penetration into the air tract depends greatly upon their size, small objects being frequently drawn into the trachea, while large objects remain in the upper part of the cavity.

SYMPTOMS.—Immediate and violent retching, or coughing if the passage is not entirely occluded, follows entrance into the larynx of any object: a reflex act calculated to dislodge it. Sometimes this succeeds, the foreign body is coughed up and out, and the patient recovers at once, although his throat may remain painful for several days. When the foreign body is large enough to fill the laryngeal cavity sufficiently to occlude it, and the first expulsive effort does not succeed, the patient, having comparatively emptied his lungs of air, finds it impossible to inhale; he makes desperate efforts to draw air into his lungs, each effort causing the offending object to impact itself more tightly in the glottis. In the great majority of cases, however, the object is of such a shape and form that sufficient air is permitted to enter the lungs to keep the patient alive. In this case the first paroxysm, although severe, subsides; violent paroxysms of coughing follow, and, after a few minutes, comparative comfort is enjoyed until another coughing spell brings on dyspnea and a renewal of the first symptoms. After a time,

the larynx seems to become accustomed to its new occupant, and a small object may even be forgotten and ejected in a fit of sneezing or coughing long after. In many cases, however, such is not the case, and organic lesions may be caused which may endanger the patient's life. The inflammation occasionally extends to the lungs, and a fatal result may be caused by pneumonia.

Again, notwithstanding the spontaneous expulsion of a foreign body, secondary inflammation may follow and endanger the patient by edema of the larynx. Under such circumstances, the patient at once experiences the preliminary stages of asphyxia; he gasps for breath and unless assistance be at once provided may die in a few moments. This is only apt to occur, however, when a mass totally occluding the larynx, such as a piece of dough or meat, becomes impacted.

Case in which a small piece of bone passed down the trachea and was lodged in the lower air passages, where it produced the symptoms of a diffuse catarrh. A year and a quarter later the foreign body was expectorated during a severe fit of coughing and then the general condition of the patient rapidly improved. Ritter (*Med. Klinik*, Aug. 27, 1911).

TREATMENT.—The simplest means are sometimes sufficient to dislodge an impacted body. A **slap on the back** during an expulsive effort while the patient is in the knee-chest position may succeed. At times, the object remains over the aperture and can easily be removed with the finger. The epiglottis may be held down by the impacted body so as to completely close the laryngeal aperture;

the finger can also be used in this case.

When the foreign body presents a certain degree of weight, such as a piece of coin, a bullet, etc., an effort may be made to cause its fall from the larynx by **inverting the body**, the patient standing on his hands while his feet are held up; or, he may be placed face downward, on a table, one end of which is then raised as high as possible.

Pins and needles, tacks, and bones—*i.e.*, objects having a tendency to penetrate into the tissues when efforts at expulsion are made which cause them to increase their hold—can be withdrawn by means of **forceps** with the assistance of the laryngeal mirror. Before cocaine was introduced, this was an exceedingly difficult procedure. With the aid of **cocaine**, however, the operation is greatly simplified; a 10 per cent. solution applied generously to the laryngeal membrane and all the parts around the larynx, including the epiglottis and the base of the tongue, so anesthetizes the throat as to render the extraction of the foreign body a comparatively easy task. Any laryngeal forceps may be employed to grasp small objects, while Fauvel's, Mackenzie's, or Cusco's may be used for large ones.

Of far greater value is **bronchoscopy**. The Jackson and the Brünings instruments for direct inspection of the lower air passages have supplanted almost entirely the earlier methods of indirect examination. Either with the speculum or the proper-sized tube, if the foreign body is below the vocal cords, the intruder can usually be located and removed with greater ease and less distress to the patient than by the indirect

method formerly used. (See the preceding article: LARYNGOSCOPY, BRONCHOSCOPY, AND PHARYNGOSCOPY.)

Since the introduction of bronchoscopy the number of foreign bodies found in the air passages has jumped from 19 in 1900 to 595 in 1911. Certain towns are becoming foci for swallowed and inhaled foreign bodies. As it is absurd to suppose that foreign bodies are being aspirated or swallowed more numerous now than in former years, the deduction is evident that many obscure and wasting affections in the past have been merely the reaction to the presence of an unsuspected foreign body in the air passages or alimentary canal. W. Brünings (Deut. med. Woch., May 16, 1912).

Eleven cases are recorded in which **electromagnets** were used for the extraction of metallic bodies from the trachea and bronchi. Seven of these cases were successful. In exceptional instances the electromagnet may prove of great value in the extraction of foreign bodies from the lungs. These cases would be limited to that group in which the foreign body was beyond the reach of a bronchoscope or was concealed in profuse secretions. The magnet may also attract the foreign body and thereby shorten the search when an external operation becomes necessary. In the vast majority of instances, however, the bronchoscope will remain the instrument of choice. Samuel Iglaier (The Laryngoscope, Jan., 1914).

Case of a child 3 years old that had swallowed an open small-sized safety-pin. The röntgenogram showed it in the region of the stomach. The child would neither eat nor drink on account of soreness, and vomited everything it swallowed. Forty-four hours later, after the passage of a No. 26 catheter into the stomach, she ate ravenously and without further trouble. The first bowel movement occurred nineteen hours later and with it the open pin was passed in

a large scybalum. R. S. Barton and H. A. Coleman (Jour. Amer. Med. Assoc., Feb. 21, 1914).

If the necessary instruments are not at hand, either for direct examination or tracheotomy, and suffocation is threatening, the trachea may be opened with a penknife and the wound kept patulous with carefully cleansed hairpins the curved ends of which are bent into hooks. The sharp ends being also bent into hooks in the opposite direction, thus forming an S, the pins are secured by means of a piece of tape passed around the patient's neck. Or, the thyrocricoid membrane may be divided, thus furnishing a sufficient opening for the admission of air until more decided measures can be adopted. Before doing this, however, it is advisable to ascertain as nearly as possible the location of the foreign body, to avoid making an unnecessary opening in case it should have fallen into the trachea. The location of the foreign body may often be ascertained by auscultation, a whistling noise being audible at the point of impaction; a stethoscope may be used for the neck; in the great majority of cases, however, the Röntgen rays will have to be employed.

Analysis of 612 cases of foreign bodies showed carelessness in this order of frequency: (a) In putting edible substances in the mouth; (b) in preparation of food; (c) in eating and drinking; (d) in permitting children to play while eating, and (e) in permitting toothless infants to eat things needing mastication. Of 590 cases, 492 were in children under 15 years. Chevalier Jackson (Trans. Sect. on Laryn., Otol. and Rhinol. of Amer. Med. Assoc., 99, 36-56, 1917).

Tracheotomy is occasionally performed to enable a foreign body im-

pacted in the trachea to be coughed out. The opening made in the wind-pipe should be longer than for the introduction of the cannula: $1\frac{1}{4}$ inches for an adult and about 1 inch for a child. The spontaneous extrusion of the foreign body is thus greatly facilitated. This method, however, is now seldom used since the introduction of the Jackson and the Brünings instruments.

Low tracheotomy, for some time obsolete, has been revived by Killian for the introduction of the examining tube and the removal of the foreign body from the bronchi, when it is impossible, for any reason, to insert the instrument through the mouth.

Jackson frequently removes foreign bodies from the lower air passages without either local or general anesthesia, but few are so skillful as to obtain the desired result without first thoroughly anesthetizing the mucous membrane with cocaine or administering a general anesthetic.

LARYNX, NEUROSES OF.

LARYNGISMUS STRIDULUS, OR SPASMODIC LARYNGITIS.

This is an affection of poorly nourished or weak children in which dyspnea, caused by spasmodic closure of the laryngeal aperture, suddenly occurs.

SYMPTOMS.—The attacks usually come on at night while the child is asleep. Awaking suddenly, the patient gasps for breath and shows every evidence of prompt suffocation without cough or hoarseness. The pulse becomes weak, cold sweats and cyanosis soon come on, and in a few moments the child may be at death's door. Often, however, after a few gasps, a quantity of air is suddenly

drawn into the lungs with a "crowing" sound, the respiration becomes more normal, and in a few minutes the child seems out of danger. This improvement is sometimes ephemeral, however, and the attack may return after a few minutes or hours, and continue several succeeding days and nights. The number of deaths in a series of 164 cases collected by Loos (Archiv f. Kinderh., B. 21, H. 5 and 6) amounted to 14.

ETIOLOGY.—There being no inflammation of the larynx, the term "laryngitis" is not applicable, a spasmodic or nervous element alone prevailing, which, according to Eschrich, is closely allied to tetany. It occurs about equally in children of both sexes, and may be caused by a nervous shock or excitement such as occurs when children are severely punished or even scolded. It occurs mainly in children who have soft bones and cartilages, flabby muscles, and general weakness; hence rachitis is considered as the main pathogenic factor in the vast majority of cases. The pressure of enlarged bronchial glands upon the vagus, adenoid vegetations, and hypertrophied tonsils seems to bear a close association with the disease. Gastrointestinal disorders and exposure to cold and damp also represent common causes of this disorder.

TREATMENT.—Measures calculated to meet the danger of suffocation, leaving the determination of its true nature until all immediate danger has been eliminated, are first indicated. A **warm mustard foot-bath** or a **general bath** usually serves its purpose very rapidly; sometimes **cloths wrung out of cold water** placed over the thyroid are sufficient, or the ap-

plication of **hot water to the nape of the neck** may bring the desired relief. Seizing the **tongue** firmly between the thumb and forefinger and making **traction** every two or three seconds will tend to excite the respiratory center by reflex action through the phrenic nerve. Should the jaws be set, the same result may be obtained by **deep pressure** with the fingers on the tissue **at the angle of the jaw**. Of value is the production of **emesis**, either by titillating the back of the mouth with a feather or administering **ippecac**. The triturate tablets of the latter drug are recommended by Northrup, 4 or 5 of the $\frac{1}{100}$ -grain (0.00065 Gm.) tablets being given every ten to thirty minutes until emesis is produced; they are specially valuable for this purpose. A few whiffs of **chloroform** or **ether** sometimes act favorably at once. The possibility of impaction of the epiglottis is to be remembered as a causative element, and, should it be found free, no harm will follow the **introduction of the finger**, which, in case of impaction, would have raised it without difficulty.

The application of a **sinapism** over the **liver** tends to prevent recurrence of the attacks. The **bromides, chloral, opium, belladonna**, etc., also act advantageously. **Morphine** injections sometimes cut the attack short in a few moments.

When all means fail to re-establish normal respiration and the dyspnea continues marked, **intubation** should be practised. If instruments be not at hand to perform the operation, the **trachea** must be **opened** or a **catheter introduced into the larynx** to temporize until intubation instruments can be obtained.

MOTOR LARYNGEAL NEUROSES.

The main varieties of **adductor paralysis**—*i.e.*, paralysis of the muscles which close the glottis—are: paralysis of the adductors or lateral cricoarytenoids; paralysis of the internal tensors of the vocal cords or internal thyroarytenoid muscles, and paralysis of the interarytenoid muscle.

PARALYSIS OF THE LATERAL CRICOARYTENOID MUSCLES.—

This variety of paralysis is that generally termed **hysterical aphonia**, owing to its prevalence among the female sex and the association it so often presents with disorders peculiar to them, neurotic and uterine. It usually comes on suddenly, the aphonia being generally total, including even, sometimes, the power to whisper. Some cases are able to sing, however, and the voice may also appear during laughter, sneezing, coughing, etc.; indeed, in every act involving vocal resonance, except talking. The vocal cords upon laryngoscopic examination are wide apart and fail to approximate when the patient is told to sound her voice, the formation of sound-waves being impossible. The mucosa in true cases of hysterical aphonia is pale. It is usually due to a shock or fright; sometimes no external cause can be found. There is, as a rule, a history of previous attacks.

Habitual pareses of the vocal cords may be engendered by autoimitation, but are not necessarily hysterical. After a child has suffered from a temporary paresis it begins unconsciously to imitate the condition, until a habit state is induced, manifested as hoarseness, whispering voice, or inspiratory stridor, according to the muscles involved. The affection almost invariably occurs in childhood, persisting sometimes into

adult life. Gutzmann (Berl. klin. Woch., Nov. 18, 1912).

TREATMENT.—In true hysterical aphonia the voice may return as suddenly as it disappeared without treatment. But therapeutic measures are required in the majority of cases, since prolonged paresis of the muscles is liable to promote their atrophy. The cases should be carefully examined and any abnormal condition corrected. **Strychnine** is always indicated. The voice can usually be brought back, by local applications of **electricity**, one pole, using Mackenzie's electrode, being inserted behind the larynx and the other, the negative pole, externally over the thyroid cartilage. A weak current is sufficient—indeed, at times, no current at all—to cure a case, the psychical effect being the main factor.

The writer pushes the thyroid cartilage to one side with sufficient vigor to cause pain, taking the patient unaware. Almost invariably this **thyroid deflection** will lead to an immediate verbal protest. Citelli (*Revue hebdom. de laryn.*, etc., Dec. 20, 1913).

Two cases of functional aphonia following the bursting of a shell in close proximity to the patient were treated by a moderate intralaryngeal **faradic shock**. Tilley (*Proc. Roy. Soc. Med.*, viii, *Laryn.*, Sect., 1915).

The writer observed 6 cases of aphonia which began in the trenches. In 4 the voice returned on asking the patient to **phonate** with the laryngeal mirror *in situ* for the purpose of examination and a mild application of the **faradic current** was effective in the other two cases. J. F. O'Malley (*Proceed. Royal Soc. of Med.*; *Med. Rec.*, Nov. 13, 1915).

PARALYSIS OF THE INTERNAL THYROARYTENOID MUSCLES.—This form of laryngeal paralysis is usually manifested by hoarseness or low-pitched huskiness.

The paralyzed muscles being tensors of the vocal cords, their mobility, as far as adduction and abduction are concerned, is practically unimpaired. When, therefore, the patient is asked to phonate while the laryngoscopic mirror is in position, the cords usually come together in the normal way, but, tension failing to simultaneously occur, an elliptical space remains between the margins of the cords. The coarse vibrations induced give rise to the characteristic voice. Paralysis of the internal thyroarytenoids may accompany various neuroses, especially neurasthenia. Local disorders, of a congestive kind, or excessive use of the voice are comparatively frequent causes of this variety of paralysis, which is, however, usually associated with other local motor lesions.

TREATMENT.—Total rest of the voice, faradization, increasing doses of strychnine, and massage of the anterior cervical region represent the indications for these cases, which, as a rule, readily yield to appropriate treatment.

PARALYSIS OF THE INTER-ARYTENOID MUSCLE.—This muscle is seldom paralyzed alone. Its position from side to side in the posterior wall of the larynx enables it to cause approximation of the neighboring portion of the cords about one-fourth of their length. When, therefore, it is paralyzed, only the anterior three-fourths of the cords are adducted, the posterior fourth remaining abducted and open. In the mirror a triangular gap may be discerned. As a result, vocal resonance is almost entirely prevented and aphonia is usually complete, or a peculiar, whistling tone is given to whatever voice may remain. It is usually caused by

prolonged catarrhal inflammation involving the interarytenoid space, and hysteria.

TREATMENT.—The treatment does not differ from that of other forms of paralysis. Any catarrhal condition that may be present should, of course, receive careful attention.

ABDUCTOR PARALYSIS.

Unilateral Paralysis of the Posterior Cricoarytenoid Muscles.—The vocal cords being separated or abducted by the cricoarytenoid muscles, paralysis of one of the latter causes the corresponding cord to remain adducted,—i.e., in the middle line or slightly beyond,—while the other cord acts normally, during phonation. The irregular, triangular space forming the glottic aperture is sufficient for normal breathing, however, in the majority of cases; dyspnea, therefore, is infrequently complained of, except under great exertion. The voice is seldom impaired, the only alteration being a certain degree of coarseness, especially marked after continued use of the voice. Examined laryngoscopically, the cord on the affected side will be seen to remain in the fixed position mentioned during inspiration.

Bilateral Paralysis of the Posterior Cricoarytenoid Muscles.—When both muscles are paralyzed, the cause is usually some central lesion. One has then a dangerous form to contend with, inspiration being almost prevented by the permanently adducted cords. The dyspnea is especially marked during inspiration; the cords being pressed downward and closer together by the air-pressure above them, through the suction induced below by the expansion of the chest. A whistling sound is heard, as the air

rushes through the small aperture left open through relaxation of the arytenoids. During expiration, the air forced up the trachea separates the cords, owing to the inclined plane of the infraglottic tissues. Though the voice is practically normal, the continuous dyspnea to which these patients are subjected is very distressing, and their continuous efforts to inhale after a few words have been uttered and the whistling noise produced give the condition a character which is not soon forgotten. Slight congestion of the tissues sometimes so increases the likelihood of asphyxia that **intubation** or **tracheotomy** is at once necessary.

ETIOLOGY AND PATHOLOGY.

—Paralysis of the abductors is frequently produced by pressure upon one or both vagi or their recurrent branches by various growths of the neck and thorax, goiter, esophageal cancer, etc. The left recurrent—curving, as it does, around the aorta—is particularly exposed to the pressure of aneurisms in this situation, causing unilateral paralysis. The motor nerves of the vagus being all derived from the spinal accessory, any growth of the brain involving the origin of the latter or the vagus itself may also give rise to abductor paralysis. Bulbar lesions, amyotrophic lateral sclerosis, and locomotor ataxia may be mentioned as among the neuroses most frequently complicated in this manner, while typhoid fever, syphilis, lead poisoning, etc., may also give rise to abductor paralysis through involvement of the nervous supply in the general toxemia. Again, the situation of the posterior cricoarytenoids outside and behind the larynx proper causes them to be

greatly exposed not only to involvement in neighboring inflammatory processes, but also to the mechanical effects of foreign bodies, hot liquids, or corrosives that may be swallowed. A long-standing paralysis of the posterior cricoarytenoid muscles is very significant of locomotor ataxia. The resulting stenosis is of slow development and the patient gradually becomes accustomed to the reduced air supply, so that, at first, he becomes dyspneic only during bodily efforts.

The writer being called to a case of dyspnea, found a marked abductor paralysis. He was obliged to do an immediate tracheotomy, but in the trachea he also found constriction. In spite of a long tracheotomy tube, the child died of exhaustion, and was found to have a large tuberculous lymph node pressing on the trachea. Delavan (*Trans. Amer. Laryn. Assoc.; N. Y. Med. Jour.*, Feb. 2, 1918).

TREATMENT.—The likelihood of cure corresponds with the degree of amenability to treatment of the original cause. Whether it be syphilis, tuberculosis, aneurism, a cerebral neoplasm, etc., local treatment is absolutely subservient to that of the primary affection, and the treatment of the latter is therefore the first indication.

Measures must be adopted to stimulate the laryngeal muscles to action. **Faradization** is the most effective agent at our disposal. The laryngeal electrode (Morell Mackenzie's) is used as follows: The electrode being connected with the negative pole of a faradic battery, its extremity is introduced into the larynx, while the positive pole is connected with an ordinary surface electrode which the patient presses over the larynx externally, or with a necklet electrode.

The extremities of both electrodes should be covered with sponge or kid, to prevent stinging. To insure penetration of the current the electrode tip should be thoroughly wetted before each operation. The manipulation of Mackenzie's electrode is like that of an ordinary laryngeal forceps, the mirror being employed to note and conduct the localization of the tip of the instrument. The nearer the paralyzed muscle the application, the better. The electrode being in position, the finger-rest on the top of the handle is depressed, and firm pressure is exerted on the neck by the other electrode. At first this manipulation is quite difficult to perform, gagging and retching preventing the introduction of the instrument. After a few trials, however, the parts become more tolerant, and the application can be borne, in the majority of cases, without trouble. Cocaine anesthesia may be used in difficult cases, at least the first few times. Each application of the current should last but a few seconds, and be repeated several times at short intervals. One sitting every day should be obtained if possible.

The current may also be applied by placing one pole on each side of the neck externally. This method is very inferior to that just described. Better than it is **electrical massage**, which is carried out by placing the positive pole, thoroughly wetted, on one side of the larynx, and the fingers of the opposite hand (that holding the negative pole and in contact with the sponge) on the other side. The fingers, having become the conductors, are moved up and down, pulp down, and pressed into the surface of the neck, in the manner practised by **masseurs**. They must also be

kept wet by occasional immersion in water.

Strychnine, nux vomica, and other nerve tonics should be used, if possible, to assist the electrical stimulus. Strychnine is especially valuable, either by the mouth or hypodermically, beginning with $\frac{1}{60}$ grain (0.001 Gm.) at a dose, three times a day, and gradually increasing until $\frac{1}{20}$ grain (0.003 Gm.) is reached. This dose cannot be taken by all patients, however, and the physiological effects of the drug should therefore carefully be watched.

Experimental research to determine whether **Meltzer's technique** can be applied in the dangerous respiratory paralysis which is a dreaded complication in operations on the brain. Their experiences were favorable. Unger and Bettman (*Archiv f. klin. Chir.*, Bd. ci, No. 1, 1913).

DISORDERS OF SENSIBILITY.

Anesthesia.—Among the central causes of anesthesia of the larynx are hysteria, locomotor ataxia, bulbar paralysis, and other cerebral focal diseases. Diphtheria is the main peripheral cause. It often paralyzes the motor (inferior laryngeal) as well as the sensory (superior laryngeal) nerves, and is frequently associated with anesthesia and paralysis of the soft palate. Artificial anesthesia is produced by certain drugs, *e.g.*, cocaine, alypin, menthol, etc.

Hyperesthesia.—Various conditions may produce a hypersensitiveness of the larynx. Previous catarrhs, especially in smokers and drinkers, may be a predisposing factor. Tuberculous and anemic persons show a tendency to sensitiveness of the larynx. The condition is not infrequently noted in hysteria and neurasthenia. It is now a well-known fact

that certain abnormalities within the nose may affect the larynx by reflex action.

Paresthesia may be of central origin, or due to some local condition. It is usually found in patients suffering from hysteria or neurasthenia. Foreign bodies, which may or may not have been removed, are sometimes a contributing factor.

TREATMENT.—If possible, the etiological factor should be determined and corrected. The general health of the patient should receive careful attention. The **galvanic** or **faradic current** may be used to advantage in cases of anesthesia.

LARYNGEAL APOPLEXY (laryngeal vertigo, or laryngeal syncope) appears to be a neurosis affecting the co-ordination of the respiratory centers and the nerves of the larynx. The symptoms manifested clinically resemble an attack of apoplexy. A transient irritation and a burning sensation occur in the lower part of the throat, and cough follows, with dimness of vision, dizziness, and unconsciousness. The attacks are usually of short duration.

TUMORS OF THE LARYNX.

SYMPTOMS.—The location of a laryngeal tumor, its size, and its nature bear considerable influence upon the symptomatology. A growth situated anteriorly in the anterior commissure may, though small, so prevent approximation of the cords as to cause complete loss of voice; on the other hand, a large, soft growth located below the cords may not interfere with adduction and only give rise to the symptoms of chronic laryngitis. Paroxysmal hoarseness is often observed in such cases, especially

after loud talking or laughing. A small tumor situated above the cords may also give rise to very little trouble and cause no subjective symptoms. In the great majority of cases, however, persistent hoarseness is the first manifestation. Dyspnea follows and gradually increases until orthopnea is threatened. If at this stage the nature of the trouble be not recognized and the growth extirpated, the patient dies asphyxiated. Small growths with long pedicles are apt to titillate the laryngeal mucous membrane, and give rise to cough or spasmodic retching. A rattling noise or coarse gurgling is also sometimes heard when such growths are present.

Laryngeal tumors may be benign or malignant.

BENIGN TUMORS.

Benign tumors usually grow slowly, and dyspnea only comes on late in their history, unless an acute cold or any local inflammation causes temporary infiltration of the tissues, when dangerous symptoms may suddenly supervene.

Singers' Nodes.—These small growths, usually observed on the superior surface of the cords, or near their edge, and usually in the anterior thirds, are the result of overuse of the voice. The first manifestation is fatigue unusually soon after beginning to sing; this is followed by gradually increasing hoarseness. The tumor varies from a pin's head to a small split pea in size, and forms the center of an areola. Often the same spot in the opposite cord is also the seat of a growth. There are often several on both cords.

Papilloma.—This variety of growth is commonly met with, especially

in children, and represents over one-half of all laryngeal tumors encountered in practice. It is usually a multiple growth and varies much in size, shape, and position. The seat of predilection is usually the vocal cord, but it may be found in any other part of the larynx. It is ascribed to inflammatory disorders of the organ, especially when in subjects suffering from diathetic disorders, or showing familial traces of syphilis or tuberculosis. They are often attached to the anterior portion of the cord, near the commissure, and may be sessile or pedunculated. The numerous papillæ cause their surface sometimes to resemble that of a raspberry, especially when dark red in color. They may be yellowish, white, or pinkish. They are occasionally observed at birth, the infant being aphonic and showing evidence of dyspnea. Digital examination or bronchoscopy are necessary to recognize them in small children. While these growths are only benign in young subjects, they nevertheless show a marked tendency to recur. When they occur after middle life they should be looked upon with suspicion. Tuberculous growths of the larynx may be taken for papillomata.

Fibroma.—Fibromata may be assimilated to nasal polypus, though they are more opaque and resistant to pressure. They are smooth and usually sessile or pear-shaped, may be whitish gray or reddish, the latter color being due to sanguineous extravasation, through coughing, hemming, etc. They are generally found near the anterior commissure upon the cords, below them, or upon the ventricular bands. They sometimes become sufficiently large to com-

pletely fill the larynx and cause asphyxia. Overuse of the voice is also thought to be their main cause; they are usually found in men.

The other varieties of benign growths occasionally met with in the larynx are **cysts**, **angioma**, **chondroma**, **adenoma**, **lipoma**, **myxoma**, and **amyloid** and **thyroid tumors**. Pachydermia laryngis is sometimes considered a tumor.

TREATMENT.—In singers' nodes **rest** is the first requisite, talking especially being as much as possible avoided. The local use of astringent solutions is generally useless. The local application of **chromic acid** with a suitable instrument and by an expert, or **galvanocauterizations**, or, again, the use for sufficiently large growths of the **laryngeal forceps**, alone affords satisfactory results.

In the surgical treatment of singers' nodes the writer considers removal by **galvanocautery** preferable to ablation by forceps or curette. The amount of tissue removed can be more exactly gauged, and the sealing of the vessels and lymphatics by the heat generated does much to prevent postoperative infection. C. J. Koenig (*Annales des mal. de l'oreille*, etc., Nov., 1910).

While the so-called "singers' nodule" (chorditis nodosa) usually occurs in singers and public speakers, it may occur in anyone who habitually misuses the voice. While faulty breathing is a factor, the principal causes are the overtension of the extrinsic and intrinsic muscles of the larynx. After the patient has learned to use the voice properly, the cause is removed and the nodule will not reappear. F. B. Laurent (*Jour. Amer. Med. Assoc.*, Sept. 30, 1911).

In the cases of all other benign growths **removal** is also necessary. In small, sessile growths this may

sometimes be accomplished by **chromic acid** or **galvanocautery**. As soon, however, as a neoplasm reaches beyond the dimensions of a split pea, removal with **forceps**, **Fauvel's** or **Mackenzie's**, or better with the **Jackson** or **Brünings** instruments, should be resorted to, after anesthetizing the larynx with a 20 per cent. solution of **cocaine**. **Tracheotomy** sometimes becomes suddenly necessary when the growths are large. General anesthesia under such circumstances can rarely be used, lest the saturation of the pulmonary residual air with the anesthetic cause death. Benign tumors do not recur at the same spot, if they recur at all.

Three cases in which diffuse recurrent papillomas of the larynx, after operation, underwent retrogression under treatment of 5 Gm. (75 grains) daily for two weeks, then 0.5 Gm. (7½ grains) of **calcined magnesia** daily for a prolonged period. In veterinary medicine papillomas are very frequent, especially in the mouths of dogs, and the heroic, while empiric remedy is calcined magnesia. *Claoué (Annales des mal. de l'oreille, etc., No. 1, 1911).*

Case of papilloma of vocal cords cured by **radium**. The patient had had her larynx cleared out every six months for over 47 years by means of cutting punches. A second case, in a girl of 17 years who had an unusually sweet singing voice, became hoarse on account of the proliferation of these papillomata, which covered the whole of 1 vocal cord and ¾ of the other. The writer did a tracheotomy under ether anesthesia, and through this wound passed a wire up through the larynx into the mouth. He thus drew up into the larynx a small smooth capsule containing 100 mg. of pure radium, between the vocal cords, where it was held for thirty minutes. Three months after this 1 treatment no

trace of the growth remained, the cords being entirely healthy in appearance and presenting no sign of disease or scar. *Abbe (Med. Rec., Apr. 13, 1912).*

On the basis of personal experience in 5 cases, the writer concludes benefit or complete cure may be confidently expected from the use of **X-rays** in simple papillomatous vegetations of the larynx. *A. G. Gray (Va. Med. Mthly., May, 1919).*

The writer obtained good results in 2 of 4 cases of recurring papilloma by the use of **radium**. He also removed by **excision** any recurring papillomas, the treatment averaging 2½ years. *Plum (Hospitilstidende, Dec. 17-31, 1920).*

MALIGNANT TUMORS.

The proportion of malignant as compared to benign growths, as shown by *Semon's* statistics, is about 1 to 7, but the fact that the former are more likely to be reported than the latter would tend to suggest that this proportion is fallacious. One malignant case in 20 would, judging from the specialists's average experience, probably be nearer the truth.

CARCINOMA.—Cancer of the larynx is somewhat more frequently observed in men than women, and, as is the case with this variety of growth in other parts of the organism, the majority of cases, about 60 per cent., are observed in subjects between the fortieth and sixtieth years. Cases are, though rarely, met with in children. Epithelioma is the variety usually observed, though all forms of cancer, even scirrhus, have been encountered in this situation.

Besides the symptoms observed in other forms of laryngeal tumor, hoarseness, dyspnea, cough, etc., glandular enlargement in the neck, and dysphagia usually appear, sometimes early in the history of the case. Pain,

another feature not complained of in benign tumors, is quite a prominent symptom and in some cases becomes intense and of a sharp, lancinating character. In the majority of cases it radiates toward the ear. The breath is fetid, the general health is undermined through general toxemia and deficient nutrition, and death usually occurs from exhaustion. In some cases, however, ulceration through the coats of a large artery may cause sudden death from hemorrhage; fatal pneumonia may be brought on by the aspiration of detritus, or asphyxia may be induced through the entrance into the laryngeal aperture of masses of food.

The laryngoscopical image afforded at first varies greatly in different cases and according to the location. It may at first resemble a benign tumor, and be taken for it; one cord may simply be enlarged, rounded at the edge, and slightly congested; a small ulcer, resembling an abrasion, may suggest syphilis, especially when the edges of the ulcer are sharp-cut and yellowish; a grayish projection or ulcer may suggest tuberculosis, etc. Elimination by examining the sputa for tubercle bacilli, or the administration of iodide of potassium, is often necessary in such cases to determine the true nature of the growth, and sometimes a small piece must be nipped off with forceps for microscopic examination. The development of the tumor is also irregular. Fungous masses, burrows, masses of necrosed tissue, and thick secretion, etc., make up a picture that is never forgotten when once seen.

The chances of recovery are absolutely *nil* when an early operation, including thorough removal of the

growth, cannot be carried out. When such a procedure can be resorted to satisfactorily the prognosis becomes comparatively favorable.

TREATMENT.—The safest rule as to the **extirpation** of laryngeal carcinoma resumes itself into instrumental methods whenever the case is seen near its incipency. If there appears, after careful examination, to be no peripheral involvement, and the growth is so situated that it can be, as it were, punched out with considerable surrounding tissue with special cutting forceps, this should be resorted to. An ulceration or thickening near or at the edge of a cord or a ventricular band may thus be enucleated. Such cases are unfortunately comparatively rare, and the laryngologist is usually consulted when the cancerous process has already advanced beyond this comparatively simple procedure. Excision then affords the only procedure capable of affording some chance of recovery. It is now advocated by most experienced laryngologists when the limits of the thyroid cartilage are not passed; that is to say, when only the tissues *within* the larynx proper are involved and when there is no glandular enlargement. Local applications of acids, cautery, arsenic, etc., but stimulate the development, and are therefore more hurtful than beneficial.

To assuage the sufferings of the patient, much can be done. The insufflation of **orthoform** or the local application of a **cocaine solution** before meals to the ulcerating tissues enables the patient to swallow his food. When he can no longer do this, a **stomach-tube** or a large rubber **catheter** may be introduced alongside the growth, into the pyriform sinus,

and the patient fed through it with **nourishing liquids**: milk and cream, soft-boiled eggs, broths, etc.

Tracheotomy, early in the case, when laryngectomy cannot be performed, by giving rest to the larynx seems to stay the progress of the growth. It should be performed low down and under strict antiseptic precautions. When the tissue involved includes only the soft structures, a **laryngofissure**, or **thyrotomy**, and **removal of the entire growth**, may give the necessary relief. When the disease is more extensive, but still confined to one side of the larynx, a **hemilaryngectomy** may sometimes be resorted to with beneficial results. A **complete laryngectomy** is done only in extreme cases and promises very little for the life or comfort of the patient.

Details of 28 cases of cancer of the larynx in which the writer operated during the last ten years. In 18 cases with an interval of over three years since the operation, 8 of the patients are free from recurrence to date, including 4 out of 5 treated by **laryngofissure**; 2 out of 10 treated by **partial laryngectomy**, and 2 out of 3 treated by **complete laryngectomy**. Koeschier (*Wiener klin. Woch.*, July 8, 1909).

There are very few organs in the body from which cancer—diagnosed in time—can be removed with as good prospects of a complete cure as from the throat. The writer has encountered 48 cases of primary endolaryngeal cancer, the patients all male but 8, and all were over 40 except 1 woman in the twenties and 1 man and 1 woman in the thirties. The proportion of permanent cures without local metastasis was thus 50 per cent. in the thyrotomy cases; 20 per cent. of the 5 cancers removed by the endolaryngeal route, and 20 per cent. of the 5 removed by total resection of

the larynx. **Thyrotomy** may be regarded as an efficient means of curing cancer in the larynx if diagnosed early. E. Schmiegelow (*Ugeskrift f. Laeger*, July 21, 1910).

The writer had 10 cases, all of which were in men between 43 and 68 years old. He made a **laryngofissure** in all cases and lost no case from the operation. Only one of the patients is dead as a result of a local recurrence. Laryngofissure alone has given a lasting cure in 80 per cent. of the cases. The resort to a secondary excision of the larynx in the cases of local recurrence has raised the percentage to 90. St. Clair Thomson (*Brit. Med. Jour.*, Feb. 17, 1912).

Early cancer of the larynx is the most curable cancer; it is intrinsic, its diagnosis can be made early, and the involvement of the lymphatic glands occurs late. The writer has performed 24 **laryngectomies** with a 7 per cent. operative mortality. The principal disabilities after operation are the peculiar voice, the personal appearance of the patient, and the predisposition to pulmonary troubles. Among the special dangers are pneumonia, local infection, mediastinal abscess, vagitis, and reflex inhibition of the heart and respiration through mechanical stimulation of the superior laryngeal nerves. G. W. Crile (*The Laryngoscope*, Dec., 1912).

SARCOMA.—Sarcoma, according to Gurlt's statistics as quoted by Bosworth, occurs once in the larynx in every 848 cases of this form of tumor met with, while general average of the cases reported by various observers would place the relative number of cases of laryngeal sarcoma as compared to laryngeal carcinoma at 1 in 23. It may be either primary or secondary.

As is the case with carcinoma, it may occur in any part of the larynx, but with a predilection for the vocal

cords. The yellow color of sarcoma as compared to carcinoma, which is usually reddish at the start; the globular or rounded surface as compared to the ulcerative process observed early in the latter, and slower growth are important features, but the diagnosis should invariably be verified microscopically. The mixed forms are sometimes met with, *e.g.*, fibro-, myxo-, chondro-, angio-, adeno-, and melano- sarcoma. The subjective symptoms are not usually as severe; indeed, the patient may otherwise be in excellent health, as witnessed in a case seen by myself, and to all intents and purposes the case may simulate in this particular a benign tumor.

TREATMENT.—Early **extirpation** of the growth affords a far better prognosis than when carcinoma is present, since glandular involvement occurs later. When the tumor has involved the greater part of the larynx, **laryngectomy** should be resorted to. In inoperable cases **radium** and the **Röntgen rays** may be used to advantage. They are also used to prevent recurrence when extirpation has been resorted to.

INJURIES OF THE LARYNX.—

External injuries to the larynx may be the result of contusions, wounds of various sorts, and fractures. The symptoms produced are usually proportionate to the amount of damage done. Contusions may produce pain on speaking and swallowing, hoarseness, and aphonia, and on examination show redness and swelling, ecchymosis, or even a free hemorrhage. Punctured wounds of the larynx may produce marked dyspnea as the result of the compression of the trachea by an extensive cutaneous emphysema. Incised wounds may produce con-

siderable damage, according to the tissue or structure cut. In these cases the hemorrhage must be controlled and the danger of suffocation averted by **tracheotomy**.

Fractures are produced in a way similar to contusions, *i.e.*, by an external blunt force. The older the person, the greater the possibility of a fracture on account of the normal ossifying processes. The fracture usually occurs in the thyroid cartilage, and runs vertically. Flattening and broadening of the cartilage, displacement, or abnormal mobility and crepitus may be ascertained. **Ice** should be applied to control the swelling and the expectant treatment adopted.

Internal injuries to the larynx may occur from cauterization and scalding, unintentional operative lesions, and rupture and hemorrhage from muscular overstraining. The treatment depends upon the symptoms produced. The use of **menthol** pastilles or the instillation of a 10 to 20 per cent. solution of menthol in oil may have a beneficial effect when the larynx has been cauterized or scalded.

Military statistics show that laryngo-tracheal injuries are not frequent. Wounds of the neck may be taken as about 3 per cent. of the total wounds. In an experience with several thousand and wounded the authors have found only about 30 wounds of the larynx and trachea.

The immediate results of laryngo-tracheal injuries are hemorrhage, emphysema, asphyxia, and sudden death. In the great majority of cases of penetrating wounds of the laryngo-tracheal tract, the respiration was compromised to such an extent that **tracheotomy** was necessary to save the life of the patient. Besides this preliminary preventive tracheotomy, the wound, as is the common practice in all war injuries, must be opened up

and cleaned and foreign bodies, etc., removed. These procedures constitute the immediate treatment.

The results consecutive to laryngo-tracheal injuries are classed by the authors as: (1) edema of the laryngeal mucosa; (2) suppurations; (3) inflammatory stenoses; (4) paralyses. Such results may necessitate a second tracheotomy. This should be systematically performed. Inter-cricothyroidean laryngotomy ought never be done, according to the opinion of the writers. Moure and Conuyt (*Revue de chir.*, xxxv, ii sem. i, 1916).

LARYNX AND TRACHEA, SURGERY OF.

THYROTOMY.—Thyrotomy is calculated to expose freely the interior of the larynx for the removal of foreign bodies and tumors. To admit air into the respiratory tract, however, in diphtheria, laryngeal edema, etc., it is not satisfactory, as a rule, being too close to the lesion for the relief of which it is practised. When a foreign body is impacted above the vocal cords and cannot be removed from above, it not only facilitates breathing, but also the removal of the offending mass. Tumors of the larynx, when situated within the larynx proper, are brought within easy access, and may be thoroughly scraped off.

The operation consists in a vertical incision through the skin in the median line and splitting of the thyroid cartilage underneath. Care should be taken to open the latter at the junction of the two alæ, as either cord may be injured if the median line is not closely followed. A sharp and strong bistoury is required. In some cases the cartilage is ossified and a fine saw must be employed. The operation is comparatively bloodless.

There is always danger of impair-

ing the voice, and it is advisable to close the wound as early as possible and with the utmost care, so that the vocal cords will be in the same relative position as before the operation. Some operators, when the larynx has been cleared of tumors, and when air must be artificially admitted into the trachea, extend the incision, performing a laryngotracheotomy in addition to the thyrotomy; close up the thyroid wound, and insert the tube below.

LARYNGOTOMY.—In case of emergency—*i.e.*, when, through the presence of a foreign body, an injury, edema, etc., air must artificially be admitted into the larynx—this operation is very satisfactory. It consists in an incision through the cricothyroid membrane in the median line from the thyroid cartilage down to the first tracheal ring. After incising the skin and on reaching the cricothyroid membrane beneath, an artery—the cricothyroid—is met with; this should be pushed aside and the membrane incised perpendicularly. In doing this, care should be taken to penetrate the tracheal mucous membrane, which tends to become detached and sacculated, thus blocking the trachea. A small tracheotomy tube should be used, and removed as early as practicable, necrosis of the cricoid or thyroid cartilages being otherwise likely.

LARYNGOTRACHEOTOMY.—When in laryngotomy the operation is extended so as to include the cricoid cartilage and the first ring of the trachea—not lower, lest the isthmus of the thyroid body be encountered—the procedure becomes a *laryngotracheotomy*. When the patient is on the verge of asphyxia, technical nicety must sometimes be sacrificed to the urgency of the case. The trachea

must immediately be opened, whether hemorrhage be feared or not, by a perpendicular incision in the skin and one a little shorter through the walls of the trachea. If nothing but a pen-knife is at hand, this may be used when cleansed, and two hairpins bent flatwise into letters S may be employed as hooks to keep the wound gaping while the patient's respiration becomes normal. Before incising the skin, however, it is always well to trace lightly, with a soft pencil, the site of the incision: *i.e.*, the middle line. If this precaution is neglected, the incision is almost always irregular; indeed, the knife may not enter the trachea at all, but suddenly plunge to one side of it. When the outline of the incision is drawn, the skin should be held firmly down in its proper place with the thumb and middle finger of the left hand, while the right does the cutting. The isthmus of the thyroid should be avoided if possible, but this is often difficult, owing to the short distance between it and the cricoid cartilage above.

TRACHEOTOMY.—The various conditions in which this operation is indicated may be divided into three classes: 1. Those in which a morbid process suddenly or gradually reduces the laryngeal lumen and involves the probability of asphyxia, such as diphtheria, croup, edema, paralysis, malignant disease, etc. 2. Those in which physiological rest tends to reduce the activity of the morbid process and delay its progress, such as laryngeal tuberculosis and syphilis. 3. Those in which an impacted foreign body cannot be removed through the glottis.

This operation, though apparently easy, is by no means so in the first class of cases mentioned, owing to

rapid perpendicular motions of the trachea when violent efforts at respiration are made. In the second class there is, as a rule, no dyspnea; hence the operation, in a thin subject especially, is less difficult, since the trachea is quiescent except when the patient swallows. The same may be said of the majority of cases included under the third class.

Anesthesia for tracheotomy should be local. General anesthesia is dangerous.

Salt solution, freshly prepared, containing 0.1 per cent. of **cocain** is used in Jackson's clinic. The injection should be intradermic, not hypodermic. Beginning low, a small quantity is injected into the median line. The needle is withdrawn and inserted at the upper border of the wheal. The needle is again withdrawn and inserted at the upper border of the second wheal, and so on upward until the region of the thyroid cartilage is reached.

The operation is performed as follows: The patient is placed on a table and the shoulders are raised on a pillow so as to cause extension of the neck. With a blue pencil, a line starting from the cricoid 5 to 7 cm. downward, exactly in median line, is drawn—the tracing for the incision. This should include the skin and platysma. Blood-vessels should now be watched for, and, if any are met with, they should be tied if at all important, or pushed aside if possible. Working down, cutting only on the grooved director, and strictly following the axis of the trachea, the rings are soon reached. If the vessels have received proper attention, the wound should be comparatively dry. The tenaculum is then used to steady the trachea, and, an assistant holding the

lips of the wound apart with hooks, the first ring of the trachea and the cricoid being respected. A violent inspiration then occurs, followed by the sudden expulsion of mucus, blood, or diphtheritic membrane if any be present: a dangerous feature for the surgeon if he is not on his guard. At this time, the patient often ceases to breathe for several seconds. Though he practically always recovers, the opening should be carefully examined lest a mass of membrane, a plug of mucus, or a foreign body be the cause of the arrest of breathing. If it is prolonged, artificial breathing should be resorted to, or the patient should be slapped on the back and suspended by the heels. Finally, as a rule, the patient takes a deep breath and the respiration continues normal. The cannula is immediately introduced, the sponges being taken off at the same time. The flow of blood ceases almost immediately upon the restoration of the normal breathing; for prudence's sake, however, the patient should be raised and leaned forward, so as to cause what blood might ooze from the wound to flow externally, instead of into the trachea. When the operation has been satisfactorily performed, the external wound above and below the tube is closed by universal suture clamps or regularly inserted sutures, care being taken to approximate and adjust the edges accurately. The lower end of the wound should remain open for drainage.

Keen introduces a silk suture into the trachea on each side of the incision and through the skin, ties the ends, and leaves them hanging long. This provides a permanent retractor with which the surgeon can at any

time open the trachea. If no tracheotomy tube is at hand, an elastic band tied around the neck can be used to connect the free ends of the ligatures, and so keep the trachea patent for free respiration.

Silver tubes are to be preferred when the instrument is to be worn a long time; aluminum tubes are the best when they are to be removed soon, since the metal is corroded by the secretions. The hard-rubber tubes are clumsy and become quickly saturated and foul. A double tube—the largest that can be easily accommodated—should always be employed. It should also be carefully tied with tapes, around the neck, particularly in children.

During the operation, and as long as the patient is confined to his room, generally about a week, the atmosphere should be kept at a temperature of not less than 80° F. (26.7° C.), and maintained in a moist state by means of steam, obtained by boiling water in the apartment. In short, the object should be to furnish the lungs with air possessing as nearly as possible the properties it would possess if it were inhaled through the nose. To further attain this object, the foreign particles floating in the atmosphere can be arrested at the mouth of the cannula by straddling a piece of thin muslin over it; care should be taken, however, not to attach it so as to interfere with the free discharge of mucus. The best means is to tie a thin muslin handkerchief around the neck above the cannula, letting it overhang its orifice. This not only prevents the ingress of dust during inspiration, but also serves to prevent the regurgitation of mucus, which often takes place without such a con-

trivance, when a coughing spell forces the discharges up to the mouth of the tube.

An important point is to keep the cannula as free as possible from the copious discharges which are formed for a couple of days after the operation. An intelligent attendant should be carefully instructed to withdraw the inner cannula every two hours, to cleanse it carefully with hot water, then to reintroduce it into the outer tube after having effectively freed the cavity of the latter of any mucus that might have accumulated there. This may be done by means of a feather, a piece of sponge, or absorbent cotton securely and tightly fastened to a suitably bent piece of thin brass wire.

The patient should be provided with two complete cannulas so as to occasionally be able to withdraw the outer tube also and cleanse it thoroughly. This can be done after a couple of days, the wound having had time to assume the shape of the outer cannula, thus enabling it to remain patulous for a short time after the instrument has been withdrawn complete. The extra cannula, previously warmed to avoid exciting cough, should be introduced immediately upon the withdrawal of the other, using, to assist its entrance, a Cohen pilot. This instrument, introduced into the outer cannula, presents a blunt-pointed knob which separates what tissues might impede the progress of the latter. It should, of course, be instantly withdrawn as soon as the tube is in position. The occasional (once or twice a week after the first few days) withdrawal of the tubes serves also to avoid what danger the corrosion of a metallic cannula might incur. Cases have been reported in

which pieces of such a cannula, broken off at an eroded point, occasioned alarming symptoms.

Occasionally, granulations are formed at the external tracheal orifice, and in the trachea itself, the latter being especially the case when a fenestrated tube is employed. Strong astringent solutions sometimes suffice to destroy them; in some cases, however, surgical measures are necessary.

When the cannula is to be withdrawn permanently, the natural breathing powers of the patient should be tested by closing the aperture of the cannula with a stopper. If this is borne without difficulty, the instrument may be withdrawn, but kept within easy reach with pilot in position, for sudden replacing if necessary. As a rule, however, this is not required, and the wound closes up after a few days to finally heal completely a week or two later.

The cannula has occasionally to be worn permanently, the patient, to speak, being obliged to place his finger upon the external opening. In this case Luer's tracheotomy tube, the inner cannula of which contains a silver pea, whose object is to arrest the expired current of air, so as to enable it to pass between the vocal bands, will be found very useful, rendering the use of the finger to close the tube unnecessary.

PARTIAL LARYNGECTOMY is a more extensive operation than thyrotomy. In addition to the growth and the involved soft tissue, a portion of the cartilaginous framework is likewise removed.

Partial laryngectomy is indicated when malignant growths are limited to one side and there is every reason to suspect that the cartilaginous and

the deeper structures are also involved in the process.

COMPLETE LARYNGECTOMY is performed only when the malignant disease is so extensive that relief cannot be secured from the simpler and less radical measures. Even should the patient recover from the operation, the condition of the individual without his larynx is a pitiable one.

After the usual preparation, the patient is placed in the Trendelenburg position, a preliminary tracheotomy performed, and the administration of the ether continued by the insufflation method. Following the incision in the median line, the soft structures are separated from the larynx as far as the anterior wall of the esophagus. A heavy anchor suture is passed through the first and second tracheal rings on either side and fastened to the skin to prevent the trachea from falling into the mediastinum. The trachea is then severed from the cricoid ring with a sharp scalpel, and its posterior surface from the esophagus with the finger or a blunt instrument as far as the arytenoid cartilages, when it is severed by a transverse incision. The wound in the anterior pharyngeal wall is closed by suturing together the lower pharyngeal and the thyrohyoid membranes. After closure of the skin incision, a thin piece of moist gauze is placed over the tracheal stump, which has been securely fastened to the skin, to moisten and filter the inspired air. The foot of the bed is elevated until the pharyngeal wound is healed and the patient can take food by the mouth. This is usually in about four days. In the mean time he is fed by the rectum. If the shock has not proven too great and the patient has not succumbed,

he should be able to leave the hospital in about two weeks.

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LAUDANUM. See OPIUM.

LAVAGE OF THE STOMACH.—By this is meant washing out the stomach with water or other fluids through a stomach-tube or catheter and then siphoning it off. Performed with proper precautions, this therapeutic procedure is both useful and devoid of danger.

APPARATUS.—An ordinary siphonage apparatus should be employed, as it is less liable to injure the gastric mucosa than the stomach-pump. A soft-rubber stomach-tube is attached by means of a small length of glass tubing to a piece of rubber 2 or 3 feet long into the free end of which is inserted a glass funnel holding about a pint. The stomach-tube, about 30 inches (75 cm.) long and from $\frac{1}{4}$ to $\frac{1}{2}$ inch (6 to 12 mm.) in diameter, should have a closed tip and two fairly large lateral openings (to give passage to solid particles of food) as near as possible to the tip; on the tube should be a mark indicating the distance from the upper incisor teeth to the stomach.

For use in infants a soft-rubber catheter (16A—24F) provided with a large lateral fenestra and joined by glass connection to 2 feet (60 cm.) of rubber tubing, to which an 8-ounce (240 c.c.) glass funnel is attached, is desirable. A mouth gag may also be required.

Before and after using, the whole apparatus should be cleansed and sterilized by allowing it to lie in an antiseptic solution and afterward rinsing in lukewarm sterile water.

SOLUTIONS.—For removing mucus from the stomach an alkaline mineral water (Carlsbad, Vichy), Carlsbad salt solution (1:250), or a solution of sodium bicarbonate (1 to 5 per cent.) may be employed at a temperature of from 90° to 100° F. (32° to 38° C.). Not more than 1 pint (500 c.c.) should be introduced at

a time, since more might overdilute the stomach. The lavage is repeated until the stomach contents return clear, unless the patient's condition prevents.

TIME FOR LAVAGE.—The best time for lavage is in the morning before the first meal; but if the patient's distress demands, it may be done three or four hours after the last meal. In severe cases both morning and evening lavage may be necessary.

TECHNIQUE.—The patient sitting in a chair or semiupright in bed, with his head bent slightly forward (to allow saliva and vomitus to escape from the mouth), faces the operator. A child may be held by a nurse in the same position. If gagging is excessive, brush or spray the throat with a 5 per cent. solution of cocaine. All dentures (artificial-tooth plates) should be removed, and the chest and lap protected by a large towel or apron. A small basin in the patient's hands will be necessary to receive any saliva or vomitus. Moisten the tube with glycerin or water and pass it along the roof of the mouth until the esophagus is reached. Instruct the patient to swallow, and the tube will be carried on into the esophagus, when the tube is then rapidly pushed on into the stomach. If the stomach contents do not immediately appear in the funnel the latter should be lowered and the contents siphoned off. Slight epigastric pressure may be required.

Having removed the stomach contents or been assured that the viscus is empty, pinch the tube close to the patient's mouth, elevate the funnel slightly, and fill it with the solution. Remove the compression from the tube and allow almost all the contents of the funnel to flow into the stomach, reserving sufficient fluid to start the siphonage. The stomach contents are then siphoned back into the funnel, by lowering the latter, and are discarded, taking care to see that approximately the same quantity that was introduced returns. This process is repeated several times, and it is desirable that the patient move about and change his position to a recumbent one, that all portions of the stomach may be reached and cleansed of its mucus.

The tube is removed, by allowing a

small quantity of fluid to remain in the funnel, and, as the tube is slowly withdrawn, this is allowed to drain back into the stomach until the tube is in the esophagus. Then pinch the tube tightly to prevent the solution from escaping into the larynx or mouth. The tube must not be removed from the stomach empty, as the mucous membrane may be sucked up into the openings of the tube and suffer laceration or injury.

In the insane or in unruly children the tube may be passed through one of the nostrils, but in this case a smaller tube must be employed and it must be well lubricated. W.

LEAD.—Metallic lead (plumbum) is not official, as it is not employed in medicine. Lead combines with oxygen to form oxides, one of which (the yellow) is official as well as with the acids and with chlorine, iodine, bromine, etc., to form salts. Of these salts the acetate is alone used internally to any extent, although the iodide has also on rare occasions been employed for alterative purposes.

PREPARATIONS AND DOSE.

Plumbi acetas, U. S. P. (lead acetate) $[(CH_3.COO)_2Pb \cdot 3H_2O]$, occurs in colorless, shining, transparent but efflorescent, prismatic crystals or in heavy, white masses, having a slightly acetic odor and a sweetish, astringent, and later metallic taste. It is soluble in 2 parts of cold and $\frac{1}{2}$ part of boiling water, in 30 parts of cold alcohol and 1 part of boiling alcohol, in 3 parts of chloroform, and in 5 parts of glycerin. Dose, 1 grain (0.06 Gm.).

Plumbi iodidum, U. S. P. VIII (lead iodide) $[PbI_2]$, occurs as a heavy, bright-yellow, odorless and tasteless powder, which is permanent in the air. It is soluble only in about 1300 parts of cold water and in 200 parts of hot, very slightly soluble in alcohol, but soluble in solutions of the fixed alkalies, of

potassium iodide, and of sodium thio-sulphate. Dose (unofficial), 1 grain (0.06 Gm.).

Plumbi nitrates, U. S. P. VIII (lead nitrate) $[\text{Pb}(\text{NO}_3)_2]$, occurs in colorless and transparent or white and nearly opaque crystals, odorless, with a sweetish, astringent taste, and permanent in the air. It is soluble in 1.85 parts of water, but almost insoluble in alcohol. Used externally.

Plumbi oxidum, U. S. P. (lead oxide; litharge) $[\text{PbO}]$, occurs in a heavy, odorless, tasteless, yellowish or reddish-yellow powder, practically insoluble in water and insoluble in alcohol, but soluble in acetic or dilute nitric acid and in warm solutions of the fixed alkali hydroxides.

Liquor plumbi subacetatis, U. S. P. (solution of lead subacetate; Goulard's extract), is a liquid which should contain in solution not less than 25 per cent. of lead subacetate [approximately $\text{Pb}_2\text{O}(\text{CH}_3\text{COO})_2$], and is made by adding a solution of lead acetate to powdered lead oxide and boiling.

Liquor plumbi subacetatis dilutus, U. S. P. (diluted solution of lead subacetate), is made by dilution of the preceding and contains about 1 per cent. of lead subacetate. Used externally.

Ceratum plumbi subacetatis, N. F. (cerate of lead subacetate; Goulard's cerate), is made from 20 parts each of solution of lead subacetate, wool fat, and paraffin, 38 parts of white petrolatum, and 2 parts of camphor. Used externally.

Emplastrum plumbi, U. S. P. (lead plaster; diachylon plaster), is made by precipitating a solution of 5 parts of soap in hot water with a solution of 3 parts of lead acetate in hot water, washing the precipitate (which consists of

lead oleate) with hot water, kneading it to dry it, and rolling the product into cylindrical forms. Used externally.

Emplastrum saponis, N. F. (soap plaster), is made by incorporating 1 part of soap, previously rendered semifluid with water, with 9 parts of melted lead plaster. Used externally.

Unguentum diachylon, U. S. P. (diachylon ointment), is made by melting 50 parts of lead plaster, adding 49 parts of olive oil and mixing thoroughly, allowing the mixture to cool, adding 1 part of oil of lavender flowers, and stirring the ointment until it congeals. Used externally.

Unguentum plumbi iodidi, N. F. (ointment of lead iodide), contains 10 per cent. of lead iodide. Used externally.

Lotio plumbi et opii, N. F. (lead and opium wash), consists of 1.75 parts of lead acetate, 3.5 parts of tincture of opium, and water enough to make 100 parts. Used externally.

Pilula opii et plumbi, N. F. (pill of opium and lead), contains 1 grain (0.06 Gm.) each of powdered opium and lead acetate.

PHYSIOLOGICAL ACTION.—Lead applied locally acts as an astringent, causing a precipitate of albumin so dense that the underlying tissues are protected from the entrance of the metal and of any other irritants that may be present. The relative absence of corrosion from lead is due both to this fact and that lead forms insoluble and consequently non-irritant salts with the strongly corrosive sulphuric and hydrochloric acids. Concentrated solutions of lead salts are, however, capable of inducing local inflammation. There is reason to believe that lead may be absorbed from the unbroken skin (Cushny).

Taken internally in therapeutic doses, lead likewise acts as an astringent, and tends to diminish the secretions of the gastrointestinal tract. Beyond these effects the manifestations are those of poisoning—especially where the drug enters the system continuously in small doses, large single doses usually causing no symptoms indicative of absorption of the drug. The nitrate, the subacetate, and the acetate are poisonous in the order named.

ACUTE LEAD POISONING.—

Acute poisoning is rare, but may occur when a soluble salt (notably the acetate) is taken in massive amounts (not less than 1 ounce is necessary to produce serious effects). The symptoms are a sweet, metallic taste in the mouth, pain in the epigastrium, and vomiting of white, milky-looking liquids or white curds, mixed with food if any food was present in the stomach. The white color indicates the presence of lead chloride, formed by interaction with the hydrochloric acid of the gastric juice. Later, irritation of the intestinal tract occurs, with an increase of pain and either diarrhea due to gastroenteritis or, in some cases, obstinate constipation is noticed. The stools are at times black in color, from the action of the intestinal hydrogen sulphide, which forms lead sulphide. The pulse in the more serious cases becomes rapid and tense, later weak and compressible. The face is anxious and may be either pale or livid. Excessive thirst is present, with cramps in the calves of the legs or muscular twitchings.

In fatal cases coma, epileptoid spasms, or collapse ensues. Up to the point of reflex (irritative) involvement of the nerve-centers (spasm, coma, or collapse) the prognosis is good; beyond this it is unfavorable.

Treatment of Acute Lead Poisoning.—If there is reason to believe that any of the lead salt is present in the stomach, the stomach siphon may be used. Any **soluble sulphate**, *e.g.*, **magnesium sulphate** or **sodium sulphate**, will decompose the lead salt and form an insoluble sulphate of lead; if used in excess the salts mentioned will act as purges and wash out the offending matter. If a sulphate be not available, **white of egg** or **milk** may be used. Cramp and spasms may be relieved by **hot applications** to the abdomen and to the extremities. Pain may be relieved by **opiates**.

In acute plumbism the writer urges care that the clothing worn during the attack be entirely free of lead. The skin should be cleansed by a **full bath with friction** or by successive **local washings**. **Mouth washings**, **careful cleansing of the teeth**, and **irrigation of the nasal cavities** with warm **saline solution** are indicated. Prompt arrest of the colic with **amyl nitrite** or **nitroglycerin** may be attempted, with subsequent use of **erythrol tetranitrate** or **sodium nitrite**. The nitrites are merely auxiliaries of **atropine** and **morphine**. Removal of the bradycardia during lead colic was observed by the writer under moderate doses of **belladonna** tincture. Where the pronounced analgesic action of morphine is no longer essential, **papaverine sulphate**, $\frac{3}{4}$ grain (0.04 Gm.), may be used to relax the intestinal spasm. Constipation is often, in the severe cases, best treated at first by daily **colonic injections of warm water**, purgatives by mouth increasing nausea and vomiting. Later, the bowels should be caused to act at least once and preferably 2 or 3 times daily. For elimination by diaphoresis a full dose of **sweet spirit of niter** 3 times, and later twice, a day is effectual. L. T. de M. Sajous (N. Y. Med. Jour., Mar. 10, 17 and 31, 1917).

CHRONIC LEAD POISONING

—The sources of poisoning by lead are very numerous. Occupations in which lead is employed, however, predominate as causative factors, and painters, white-lead-paint mixers or grinders, wall- and other paper- mill operators, glaziers, plumbers, electricians, typesetters, etc., are the victims in the great majority of cases.

Adulterated foods and liquids represent the main sources of poisoning among those whose occupations do not involve exposure. Cooking utensils painted white inside, bread made of flour contaminated with a lead-filled grindstone, cake colored with lead bichromate to avoid the use of eggs, imperfectly burnt pottery, fruit-jars glazed with lead, tins of meat closed with it, etc., are many media through which lead can reach the system. A fruitful cause of poisoning is water conveyed through lead pipes, the lead being slowly dissolved. When, however, the water contains even a minute quantity of lime salts, an insoluble coating is formed which arrests all further action as soon as the inside of the pipes is completely covered. Cosmetics, hair-dyes, face-powders, and leaden toys occasionally cause plumbism. Lewin has observed many cases from swallowed shot, holding shot in the mouth, inhalation of lead-laden air, lodged bullets, etc.

Constitutional Effects.—Slow absorption of lead, whether due to industrial or accidental causes, mainly affects the muscles, the peripheral nerves, the liver, and the kidneys. The symptoms vary considerably in different cases. Pallor of muscles and mucous membranes is an early result, fibrosis occurring in advanced cases, accompanied by degenerative changes in the nerve-endings. These changes become less

marked as the spinal centers are approached, the spinal cord being usually normal. The brain, however, is not so exempt from morbid changes, periarteritis being the chief pathological change caused.

A blue line along the margins of the gums, at the base of the teeth, is an important sign. It is especially marked in persons who are not cleanly as regards their mouths, and is due to precipitation of lead sulphide by the hydrogen sulphide set free through the activities of bacteria. Anorexia, nausea, metallic taste, and fetid breath are other common symptoms.

Anemia.—Destruction of red cells to an excessive extent is believed to occur in lead poisoning. Jaundice and a deeply pigmented urine may result. A characteristic condition of the erythrocytes is that of "basophilic degeneration," which consists in the presence in these cells of granules staining with basic dyes, and is often among the earliest manifestations of lead poisoning. Weakness, lassitude, amenorrhea, and abortion are among the accompaniments of saturnine anemia.

The blood-picture becomes modified very early in the course of lead poisoning. More than 100 granulated red corpuscles per million should be accepted as an index of lead poisoning, the number usually ranging between 300 and 3000; in 1 case of suicide with white of lead, 38,000 granulated corpuscles per million were encountered. Malaria alone is liable to mislead in this respect. Schmidt (*Deut. med. Woch.*, Nov. 18, 1909).

Lead Colic.—This symptom is most frequently met with in painters who mix and use white lead. The abdominal cramp is usually very severe, the muscles being rigid and contracted. A peculiarity of the pain is the fact that

the location of its greatest intensity is usually around the umbilicus. It occurs in accesses, often accompanied by nausea or vomiting. Relief is frequently procured by exerting pressure upon the umbilical region. The tongue is white and contracted and there is thirst, which is sometimes intense. Obstinate constipation is the rule. The face is pale or jaundiced. The pulse is slow and firm, and the rate of respiration may be increased. Vascular spasm is believed to exist both during the attacks and in the intervening periods, and the blood-pressure is, as a rule, high. Parotiditis may also occur.

Tanquerel and Planches, among 1179 patients suffering from lead colic, observed a heart rate of 20 to 60 a minute in no less than 678 cases. The bradycardia was found by the authors to be a true bradycardia, in the sense that there were no extrasystoles. The whole heart was involved. The rate was increased by atropine. The bradycardia depended neither upon the arterial hypertension usually present, nor upon the abdominal pain, but appeared to be due to the direct action of the poison either upon the trunk of the vagus nerve or its terminals in the cardiac sinus. C. Lian and E. Marcourelles (*Presse méd.*, Feb. 8, 1913).

In a series of 72 cases of chronic lead poisoning observed by the writer, constipation, pallor and anemia, blue line and tremor were constantly observed, besides basophilic degeneration. These are the six cardinal signs. Apfelbach (*Amer. Jour. Med. Sci.*, Dec., 1918).

After continuing for a period varying from a few hours to several days, the symptoms gradually recede and the access ceases. When no treatment is resorted to and the causative occupation is continued, the attacks return frequently, and death may finally occur through

cachexia or anemia, paralysis of the respiratory muscles, chronic nephritis, cirrhosis of the liver, or through some intercurrent disorder.

In 16 patients with old embedded leaden projectiles, unaccountable symptoms had been observed—hypertension, albuminuria and casts, constipation, colic, and anemia. The urines showed lead in 6 of the 16 to the amount of 0.5 to 1 mg. per liter of urine, or an excretion of more than 1 mg. daily. The intestinal and nervous symptoms could not be relieved, but in 3 cases the albuminuria disappeared completely within 2 to 3 weeks after removal of the lead bullet. Two patients with anemia and basophilic granulations were benefited. Loeper and Verpy (*Progrès méd.*, xl, 81, 1916).

Lead Paralysis.—In the cases developing slowly, paresis of various systems, central and peripheral, frequently occurs, the most characteristic of these being wrist-drop, usually bilateral, due to paralysis of the extensor muscles of the forearm, the supinator longus, however, generally remaining normal. The causative condition is a peripheral neuritis, though the anterior horn cells are sometimes secondarily involved. Anesthesia may temporarily accompany the paralysis. More frequently there are sharp joint pains (lead arthralgia).

Vertigo, loss of memory, disturbances of the special senses (amblyopia), cerebral palsies, hemiplegia, and monoplegia have also been noted.

Lead Encephalopathy.—In occasional cases marked cerebral symptoms occur. These may develop gradually or quite suddenly, violent headache, vertigo, tinnitus, strabismus, and other cerebral manifestations presenting themselves. Convulsions, amaurosis, delirium, and coma, or a condition simulating epileptic fits, hallucinations, mania, melancholia, and hysteria are at

times met with. Saturnine epilepsy is a dangerous manifestation and usually ends in death. According to Oliver, alcoholism predisposes to lead encephalopathy.

Seven cases in which lead poisoning was responsible for affections of the central nervous system, mostly merely subjective disturbances. This lead neurasthenia is far the most frequent manifestation of lead poisoning. Violent and protracted headache was the predominant symptom in 4 cases, and vomiting in the morning in 3. Violent abdominal pain is also frequent, differing in many respects from lead colic. The patients may become depressed, irritable, and timid. Hirsch (*Deut. med. Woch.*, Feb. 19, 1914).

General Disorders Due to Lead.—

Lead may act as an etiological factor in many diseases, *e.g.*, arteriosclerosis and gout. Its rôle as such is fully considered in the articles upon the various affections, and does not require detailed repetition here.

In a study of 274 cases of lead poisoning, the writer found renal disturbance in 178. Transient appearance of albumin, tube casts and sometimes of kidney cells may be the first sign to call attention to the lead poisoning, or it may accompany lead colic although not directly connected with the latter. When they persist a change of occupation should be insisted on. Gigliolo (*Ramazzini* p. 201, vol. ix, in *Jour. Amer. Med. Assoc.*, July 28, 1917).

Treatment of Chronic Poisoning.

—The indications are to remove the causes, as well as the poison already in the body, and to treat the lesions or tissue-changes produced by the poison. Frequent doses of **magnesium sulphate** will not only relieve the colic, but will convert any lead present in the gastrointestinal tract into an insoluble sulphate, and cause its expul-

sion from the body. Deléarde recommends **saline hypodermoclysis**, and Mattirlo administered $\frac{1}{2}$ grain (0.03 Gm.) of **erythrol tetranitrate** in a high-tensioned case with benefit. **Jalap** and **calomel**, guarded with **opium** to prevent griping, and **alum** in 2-grain (0.12 Gm.) doses with **opium** or **morphine**, are suggested as valuable remedies. Where administration of a saline purgative to relieve constipation is not feasible because of vomiting, large **enemas** may be employed. When cerebritis is present a **blister** may be applied to the nape of the neck, and **revulsion**, **amyl nitrite**, and **sweating** (by means of **pilocarpine**) may be tried.

Severe case of lead poisoning with encephalopathy in which purgation, baths, and lumbar puncture failed to quiet patient. A **fixation abscess** was formed by injecting 30 minims of **turpentine oil** into the thigh. Cerebral excitation diminished next day, and there was rapid general improvement. Van Haecke and Leclercq (*Echo méd. du Nord*, July 31, 1910).

Two cases of lead colic in workers on brass. Prompt benefit was derived from a suppository with 0.0005 Gm. ($\frac{1}{420}$ grain) of **atropine**. The use of 1 or 2 such suppositories is suggested in all cases of lead colic. The poisoning occurred from years of breathing minute amounts of lead in working with emery and on brass containing 1 per cent. of lead. Althoff (*Münch. med. Woch.*, Mar. 11, 1913).

In lead colic the author at once gives 1 or 2 hypodermic injections of **morphine**, to relieve pain and calm excitement. On the second day, **atropine sulphate** is given hypodermically, at first twice a day, in doses of half a milligram (gr. $\frac{1}{420}$), morning and evening, later three times a day. In some cases **fomentations** are applied to the abdomen; in others **ice poultices** are used.

By this treatment the colic is relieved. The vomiting ceases on the third or fifth day in severe cases; in milder ones it is relieved immediately, and small quantities of milk and water are allowed. Half a gram ($7\frac{1}{2}$ grains) of powdered **scammony** is then given as a laxative.

As a result of the administration of atropine, spasm of the intestines abates and a light purgative is sufficient to bring about evacuation of the bowels. Albert Mathieu (Paris méd., Nov. 1, 1913).

To eliminate the lead the sheet-anchor is **potassium iodide**, given in doses of 10 to 20 grains (0.6 to 1.2 Gm.) three times daily. It is believed that a double soluble salt (potassic iodide of lead) is thus formed, which may be excreted by the kidneys through the urine and by the liver through the bile. **Hot baths** and **diuretics** may be ordered to promote elimination. Paralysis is an indication for the exhibition of **strychnine** in large doses, during treatment with potassium iodide (given separately), and the employment of **massage** and **electricity**. The induced (faradic) current should be employed if the muscles react; if they do not, the galvanic current is indicated. When no reaction to the direct (constant or galvanic) current is observed, the paralysis is seldom recovered from. In arthralgia and lead encephalopathy **opium** or **chloral hydrate** may be required.

In all cases **removal from the source of poisoning** should be insisted upon and a strengthening **diet** ordered. **Iodide of iron** is recommended for the anemia.

Iodine seems to lose its efficiency in hastening lead elimination when it is given for a material time. This can in a measure be overcome by giving an intravenous injection, in

one of the veins of the arm, of 3 grains (0.2 Gm.) of **sodium iodide**. By mouth the author generally uses also sodium iodide, but sometimes alternates it with the **potassium salt**. The iodide should be given at first in 3-grain (0.2 Gm.) doses in a glass of milk or water, on an empty stomach, three times a day, to be followed at night by $\frac{1}{2}$ to 1 ounce (15 to 30 Gm.) doses of a saturated solution of **magnesium** or **sodium sulphate**, well diluted. Large quantities of milk or water should be taken throughout the day. A weekly urinary analysis is imperative, and if the elimination of the toxic material decreases an increase is made in the iodine salt, given even up to 60 grains (4 Gm.) daily.

For the constipation, no remedy compares with **alum** when colic is present:—

R. Alum 3ij (8 Gm.).

Diluted sulphuric acid. 3j (4 c.c.).

Distilled water, .

Syrup of orange

flowers of each 3ss (15 c.c.).

M. Sig.: A dessertspoonful (10 c.c. — $2\frac{1}{2}$ drams) every four hours in hot water.

For wrist-drop or other local manifestations of nervous involvement, the author injects **strychnine**, employs daily **massage** of the parts, and also uses **passive hyperemia**, applying a rubber bandage 10 feet long around the upper arm, where it should be allowed to remain at least thirty minutes. After its removal the forearm is soaked in **hot water**, and is then ready for **galvanic electrical treatment**. A. F. Stuart (N. Y. Med. Jour., Feb. 27, 1909).

Sweat baths with or without the use of **sulphides** are useful in lead poisoning. A **sulphur bath** may be obtained by dissolving 6 ounces (180 Gm.) of **potassium sulphuret (sulphide)** in half a tubful of water. Above all, daily physical work, preferably out of doors, favors elimination. Fantus (Ill. Med. Jour., May, 1910).

Lead carbonate is so much more toxic than the lead sulphate that lead workers, as well as the State, should aim at the elimination of the use of the carbonate in all industries in which this is possible. In addition to other prophylactic measures, lead workers should drink a glass of milk between meals, in order to diminish the chances for any swallowed lead to be dissolved by the free hydrochloric acid of the gastric juice, as in some persons there is considerable secretion of gastric juice in the empty stomach. A. J. Carlson and A. Woelfel (Jour. Amer. Med. Assoc., July 19, 1913).

Employment of **electrolysis** or **de-ionization** in incipient industrial lead poisoning advocated. Double (arm-and-leg) baths were used, the arms being placed in one bath, the legs in the other, and the current thereby made to pass through the whole body. The bath was given daily or every second day, at 16 volts and 20 to 40 milliamperes. The positive pole was placed in the foot bath and the negative in the arm bath. If the current is introduced gradually by a suitable rheostat no shock is felt. The resistance of the bath water is reduced by adding common salt. Fourteen workmen especially pale and cachectic were treated. Under the treatment the muscular power improved, the pallor of the face lessened, and the men experienced a feeling of well-being to which for months they had been unaccustomed. Recovery from complete wrist-drop was hastened. In the bath-water lead was found. The blue line on the gums gradually faded away. Sir T. Oliver (Lancet, Aug. 23, 1913).

A positive Wassermann reaction does not seem to exclude metallic poisoning, especially by lead, in favor of syphilis in primary nerve or tract degenerations. In the treatment Gowers cautions against a too free use of iodine, since the influence of the metals upon nerve-structures is exerted largely through the blood, and the throwing of a large quantity

of metal suddenly into the circulation may aggravate the symptoms. **Calcium permanganate** ($\frac{1}{4}$ gr. t. i. d.) is recorded to be of value by Stephens. A **fixation abscess** induced by **subcutaneous injections** of 1 c.c. of **turpentine** has resulted in marked improvement. G. A. Moleen (Amer. Jour. Med. Sci., Dec., 1913).

THERAPEUTICS.—Lead is never given to affect the system at large. It is used only for the local effects, which differ according to the form used. Lead acetate is an astringent remedy sometimes used to arrest **hematemesis**, especially when due to **gastric ulcer**. It is also recommended in **chronic gastritis** with **pyrosis** and **gastralgia**. In the **diarrhea** of **phthisis** and in **summer diarrhea** a few grains of the acetate, with a small dose of opium or morphine, not infrequently bring relief. In **acute** and **chronic dysentery** an enema of 4 grains (0.25 Gm.) of the acetate, $\frac{1}{2}$ grain (0.03 Gm.) of morphine acetate, and 1 ounce (30 c.c.) of warm water is useful to relieve the tenesmus and reduce the frequency of the stools.

In **cholera** and the purging from **dysentery** and **typhoid fever** a few grains of the acetate may be combined with starch and a moderate dose of opium, and be given in an enema. If it is to be taken internally, pills should be prescribed, to defer its action until it has entered the intestine. The acetate may also be combined with opium in suppository for checking various forms of **diarrhea** and for the relief of **irritable conditions** of the **rectum**.

Externally, an excellent application to **burns** is white-lead paint (lead carbonate and linseed oil), especially if the surface is not very large and there are no fears of excessive absorption.

Lead lotion (liquor plumbi subacetatis), diluted with 3 or 4 parts of water, is a good application in **eczema** where there is much weeping. Its use in combination with laudanum (lead water, 4 parts; laudanum, 1 part; water, 16 parts) has long been a favorite measure in the treatment of **inflamed surfaces, bruises, sprains, fractures, blisters, scalds, excoriations, and fissured nipples.**

Lead acetate is a useful application for the **dermatitis** produced by **poison-ivy** (*Rhus toxicodendron*), as the lead precipitates the non-volatile oil of the poison. For this purpose Hare advises that 8 grains (0.5 Gm.) of lead acetate be dissolved in a pint (500 c.c.) of alcohol and used as a wash; cooling applications should follow, but ointments should be avoided, as they dissolve the poisonous oil and spread the irritation.

In **pruritus vulvæ** lead water or cerate may be used locally. Helva recommends the application of equal parts of lead plaster and linseed oil for **sweating feet.** They should be applied on linen, wrapped around the feet every third day. Powdered lead nitrate is useful in **onychia.**

In **gonorrhea** and **leucorrhea** a solution of lead acetate (3 or 4 grains—0.2 or 0.25 Gm.—to the ounce—30 c.c.—of water) may be used as an injection. Lead preparations should never be used in eye lotions, as they are apt to deposit the lead in the tissues of the cornea and leave permanent white patches, especially if ulceration of the cornea be present.

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LEECHING.—This procedure is resorted to for the abstraction of blood from congested areas inaccessible to wet cups.

Two varieties of natural leeches are available: the small American leech, which has a capacity of about a dram (4 c.c.) of blood, and the Swedish leech, the capacity of which is three or four times as great. One to 6 leeches may be applied at one time if desired. They should, however, never be applied to regions supplied with much loose connective tissue (eyelids, labia, scrotum, or penis), as extensive ecchymosis may result. They should not be applied directly to an inflamed surface, as their bite is irritating, but rather to the periphery. They should not be placed on conspicuous portions of the body, nor directly over a superficial artery, vein, or nerve. They are generally applied to the temples or the back of the neck in cerebral congestion or inflammation, in front of the tragus or to the mastoid in acute otitis media and acute mastoiditis, to the coccyx in congested or inflamed hemorrhoids, and to the perineum when the labia, scrotum, or penis are inflamed.

TECHNIQUE.—To avoid infection the site of the leeching should (if hairy, be first shaved) be washed with soap and water. The leech, in a pill-box, wine-glass, or test-tube, should be applied to the part and confined until it takes hold. Puncture of the skin or rubbing it with sweetened water or milk will favor the process. When the leech has taken hold it should not be disturbed until it drops off, which it will do when filled. Sprinkling salt over it, however, will cause it to let go. The application of hot fomentations will increase the amount of blood removed. When the leech drops off, bathe the bite with sterile water and apply a gauze dressing. If the bleeding continues and is troublesome, it may be controlled by compression, adrenalin solution (1:1000), alum, or tannic acid. If these fail excise the bite and suture the tissues.

Leeching followed by cupping is considered superior to venesection by the writer. Two groups of 3 or 4 leeches are applied, each group in a

liqueur glass, some distance apart on the lateral aspect of the thorax or abdomen. A flow of blood having thus been well established, the gorged leeches are removed, and the hemorrhage maintained or accelerated at will by applying cups alternately to the 2 groups of leech wounds. L. Plantier (Paris méd., Aug. 19, 1916).

The artificial leech consists of a small cupping apparatus and a scarifier. With this an ounce (30 c.c.) of blood may be withdrawn.

W.

LEISHMANIOSIS. See KALAZAR.

LENTIGO.—DEFINITION.—Lentigo (ephelides; freckles) consists of yellowish, brownish, or blackish spots of pigment of the size of a pinhead or as large as a pea, occurring chiefly on the face and hands. Their gross appearance is familiar to everyone.

ETIOLOGY.—Freckles are usually due to the action of the chemical or actinic rays of the sun, although they may also be produced by exposure to arc light or to the X-rays. Congenital predisposition is believed by many to be necessary. They are more marked in persons of fair skin and in mulattoes, particularly in those having red hair and gray eyes. They generally appear during the summer and fade more or less completely during the winter. It is occasionally observed as one of the senile changes of the skin.

PATHOLOGY.—In freckles there is an increased deposit of pigment in circumscribed areas of cells in the basal layers of the epidermis.

TREATMENT.—An exfoliation of the epidermal cells containing the pigment is the object sought in treatment. **Mercury bichloride, acetic acid, sodium thiosulphate,** and similar preparations are used. Schamberg finds the following useful:—

R. Hydrargyri chloridi corrosivi ... gr. iv-vj.
(0.2(-0.4 Gm.).
Glycerini f5ij (7.5 c.c.).
Alcoholis,
Aquæ cologniensis,
Aquæ āā f5iiss (45 c.c.).—M.

W.

LEPROSY.—DEFINITION.—Leprosy is a chronic infectious disease closely allied to tuberculosis, acquired by inoculation with Hansen's *Bacillus lepræ*.

VARIETIES.—It is customary to divide leprosy into two—sometimes three—general forms, the *tuberculous* and the *anesthetic*, the former being characterized by infiltration of the subcutaneous or submucous tissues and the formation of tubercle-like nodules; the latter by anesthetic areas denoting infiltration of the nervous supply.

SYMPTOMS.—The earliest symptoms of leprosy in the majority of cases, according to Morrow (who claims to have first called attention to the early evidences in the nasal mucous membrane) and other observers, are alteration of the voice, betrayed by a slight husky or rough phonation,—Besnier's *voix lépreuse*.—which he likewise considers an early sign; rhinitis, with an abnormally free nasal secretion, sometimes epistaxis, and an increase in the salivary secretion.

Sticker noted that the nasal membrane could appear normal in the first stage or at most show a slight increase of secretion. The first visible change is a simple dry catarrh in circumscribed patches, which eventually present a raw surface. In advanced cases shallow or deep ulcers are visible in one or both sides of the septum. Sometimes there is only a hard swelling, which may extend to adjacent parts and produce stenosis.

In 1920 there were 242 cases in the United States, including: Louisiana, 87; California, 39; Texas, 33; New York, 28; Massachusetts, 13; Minnesota, 10; Florida, 7; Pennsylvania, 6; Connecticut, 5; New Jersey and Colorado, 3 each; Illinois, South Carolina and Wisconsin, 2 each. Philippines, 5500; Hawaii, 700; Canal Zone, 80; Porto Rico, 50. Hoffmann (Trans. Amer. Med. Assoc., Apr. 26, 1920).

Leprous lesions of the nasal fossa, the mouth, throat, and larynx were found by Jeanselme and Laurens in 60 per cent. of the cases examined.

The systemic invasion of leprosy is usually slow, years rather than months constituting the period of incubation. Occasionally, however, its onset is sud-

den and the disease progresses rapidly. The prodromal symptoms are mainly those of general neurasthenia: anorexia, chilliness, slight ephemeral fever, mental inaptitude, drowsiness, dyspepsia, vertigo, etc. These manifestations occur by exacerbations, and their recurrence is attended by more or less marked impairment of sensibility and other cutaneous functions, perspiration, etc., over restricted areas, fugitive erythema-like spots.

There is usually observed an essential leprosy fever due to the presence of *Bacillus lepræ* or its toxins. This fever is always intermittent, if uncomplicated. It may occur at any period of the disease, including the so-called prodromal period of some writers, and may or may not be accompanied by an eruption. Since all forms of leprosy depend on the same organism, the fever probably occurs in all, although in varying degree. When fever of a continued type is observed, it is due to the presence of other toxins acting either with, or entirely apart from, those of *Bacillus lepræ*.

In the morning the pulse rate is higher than at evening, often markedly so. This condition is not due to the greater morning activity of the patient or to atmospheric changes. Honeij (Boston Med. and Surg. Jour., Feb. 12, 1914).

After the foregoing symptoms have shown themselves with varying activity at various times, receding as often with more or less rapidity and completeness, the erythematous spots become more persistent, are more highly colored and sensitive to the touch, and project beyond the surface to a greater degree. They are reddish brown, gray, dark yellow, or bronze, and of varying size from that of a dime to that of the palm. They may appear over any part of the body, the face, the trunk, and extensor portions of the limbs. After a time these spots also disappear, leaving a discolored patch, which in dark-skinned persons, such as the residents of South American countries, appear white as compared to their surroundings.

In some cases I had occasion to see in Mexico the appearance of the patients suggested the spots on leopard skins.

Tuberculous Leprosy.—It is in this form, that most commonly observed, that the nasopharyngeal phenomena are most marked. The patient experiences slight difficulty in breathing through the nose, and the symptoms pertaining to the air tract already described become quite marked. Then comes the period during which the cutaneous lepromata of Leloir are formed.

Just as in tuberculosis the existence of a pretuberculous stage is sometimes recognized, there is in leprosy a stage of latency or preleprosis preceding the development of the more characteristic symptoms. Fever, intermittent, continuous, or irregular, and refractory to quinine, may be present years before the typical signs appear. Other early manifestations are weakness, lassitude, backache, dizziness, drowsiness, disturbances of the sweat function, precordial oppression, dryness of the nasal mucous membranes, and epistaxis. Barbézieux (Revue de méd., July, 1912).

Localized nodosities appear over various regions,—the face and hands particularly,—varying in size from small shot to a chestnut. The skin appears much thickened, hardened, and puckered, wrinkles being turned into deep furrows; the hairs are often changed in color and fall out. The projecting portions of the head—the nose, chin, and ears—taking part in the thickening, the face acquires a characteristic expression which fully accounts for the horror inspired by these wretched cases. The extremities, especially the hands and feet, are generally affected in the same way. Their skin being thickened and furrowed, they stand out stiffly and are used with difficulty.

The thickened areas, or "tubercles," do not all follow the same course. Some recede, leaving a depressed, more or less pigmented spot, while others proceed to ulceration. These ulcers are usually small, vary in depth, and their borders, as in the case of syphilis, are sharp-cut and have indurated edges. They heal and reappear several times in succession. When the ulcerative process invades the deeper tissues, they destroy them; mus-

cles, tendons, and even bone yield to its ravages; hence the mutilating effects of the disease. The mucous membranes of the mouth, tongue, pharynx, and larynx take part in the destructive process. The nasal bones and cartilages are markedly involved, the typical "saddle nose" indicating destruction of the supporting framework. A sniffing respiration indicates more or less obstruction to the respiration, by neoformations or depressed soft tissues.

Tuberculous leprosy progresses slowly: eight to ten years, on an average. It is attended by eruptive and febrile exacerbations, each being followed by a period of comparative quiet. Gradually, however, the patient succumbs through invasion of the viscera, and death usually follows some intercurrent disease: pneumonia, pleurisy, etc.

Macular leprosy is described by some writers as a third type of the disease, and in a few cases the macules constitute practically the only symptom. Practically all of the cases seen in New York are of the tuberculous or mixed type, the cases of pure nerve leprosy being extremely rare. H. Fox (New York Med. Jour., Apr. 15, 1911).

The blood serum of 100 cases of undoubted leprosy in males was examined by the writer. Of this number 34 were nodular, 52 of the anesthetic, and 14 of the mixed form of leprosy. The positive Wassermann reactions for these several types were 17, 16 and 8, respectively, or 41 per cent. The author contends that the Wassermann reaction is characteristic of leprosy in these cases, even though not syphilitic. Iyengar (Indian Journal of Medical Research, Oct., 1919).

Anesthetic Leprosy.—In this variety the spots are not as numerous, and often begin in the palms and soles. They resemble those in the tuberculous form, being erythematous and hyperchromic. But disorders of sensibility are more marked from the start: hyperesthesia usually precedes anesthesia, and may be discerned not only over the erythematous areas, but also over apparently healthy regions.

According to Dehio, leprous skin-spots do not correspond to the distribution of the nerves, but may spread in all directions. Baelz observed that when the body of a leper was rubbed with a powder of fuchsin methyl violet, then covered closely with absorbent cotton, and pilocarpine was injected into the patient, the healthy perspiring skin became colored, whereas the leprous non-perspiring spots did not.

The anesthesia is so marked that pin-pricks, burns, etc., are not felt. On the other hand, prickling and violent shooting pains are often complained of, certain nerves, particularly the ulnar and brachial, being sometimes greatly thickened and extremely sensitive to pressure. There is also exaggeration of the tendon reflex. Paralysis of several muscles may occur, with all its attending complications. Considerable mutilation occurs in this form: the toes and fingers are destroyed, the loss being unattended by physical pain.

The general health gradually succumbs to the ravages of the disease, and, the viscera becoming involved, albuminuria, diarrhea, pneumonia, or some other intercurrent disorder ends the patient's suffering.

Complications of Both Forms.—Ocular affections of leprosy were studied by Panas. In the anesthetic form lagophthalmos, xerosis of the conjunctiva, iritis, cataract, and phthisis bulbi are frequent; in the tuberculous varieties the cornea and conjunctiva are the chief seats of the lesion, though sometimes the iris, lens, and whole globe become implicated. The favorite seat is the corneoscleral border, proceeding thence into the corneal substance and to the deeper tissues.

Mental disorders are occasionally observed, melancholia especially. Inflammatory and diathetic disorders of the brain and spinal cord have also been noted.

Lepers, male and female, suffer from marked deterioration of the genital functions, and male lepers generally become impotent.

DIAGNOSIS.—The reported increase of leprosy in the United States to approximately 500 cases renders the recognition of the disease important.

The increased number of imported lepers in this country indicates either that our quarantine against the disease is inefficient, or that the quarantine officials are unable to diagnose the disorder. The trouble in diagnosis lies more with atypical cases, with incipient tuberculous cases, and with those anesthetic cases which no longer present active skin manifestations. Another source of confusion in diagnosis lies in the changes that appear in lesions during the periodic occurrence of exacerbations accompanied by lepra fever. I. Dyer and R. Hopkins (Jour. Amer. Med. Assoc., Sept. 10, 1910).

The diseases from which leprosy requires differentiation are syringomyelia, ainhum, tuberculosis, and syphilis. The similarity between leprosy and the two diseases first mentioned is such that they have been considered identical by some competent observers.

The search for the bacillus may often be facilitated by the induction of abundant nasal secretion through administration of potassium iodide (4 Gm.—1 dram—in one day). In several cases in which examination for the bacillus was negative their presence was readily demonstrated in the increased mucous discharge which ensued the day after administration of potassium iodide. Leredde and Pautier (*Revue Française méd. et chir.*, Jan. 12, 1903).

Salient points of diagnosis in leprosy consist in the recognition of the stigmata of the disease which is always suggested by the dusky hue, the swollen skin, the overhanging eyebrows, and the raucous voice. The hands, too, have a thinned epidermis and an altered color which is different from that in any other disease. The presence of tubercles in the skin of the face, at the lips and about the nose, with others in the pendulous parts of the ears—all these should make a case suspicious. The distinctive diagnosis of leprosy, clinically, is at all times simple. There are only two conditions which at all

resemble tuberculous leprosy, iodism and disseminated tuberculosis cutis. The first-named condition is seldom seen in the areas common to leprosy and the nodules of iodism are highly inflammatory and ready to break down. With tuberculosis of the skin, the lesions are numerous, small, and deep-seated, under the epidermis as a rule. They are dirty white in color and seldom assume a reddened hue. Dyer and Hopkins (Jour. Amer. Med. Assoc., Sept. 10, 1910).

Three laboratory methods of diagnosing leprosy: 1. Removal of a bit of tissue—even if it be only a macule or erythematous patch—and staining for the leprosy bacillus. 2. Examination of nasal mucus. Where the coryza usual in the leprosy is absent, 1 dram (4 Gm.) of potassium iodide should be given on two successive days to bring on secretion. Karliniski's acid-fast bacillus, apt to be mistaken for Hansen's leprosy organism, can be distinguished from it by its ready growth on ordinary media and the fact that it is pathogenic to guinea-pigs upon intraperitoneal injection. 3. Intracutaneous injection of $\frac{1}{20}$ c.c. of Rost's leprolin, previously heated at 120° C. for twenty minutes. Leprolin is made by maceration of leprosy nodules and filtration, contains toxins, and was originally intended as a therapeutic agent analogous to tuberculin. In normal individuals, injection of leprolin causes non-specific local reaction similar to that due to concentrated tuberculin. In the leprosy, on the other hand, there follows the formation of a small red nodule which in three days attains the size of a dime, with surrounding roseate area the size of a silver dollar. About the fourth there appears in its center a purplish spot, and later a small scale, which falls off on the twelfth to the fifteenth day. L. M. Pautrier (*Presse méd.*, Mar. 14, 1914).

Syringomyelia.—In this disease Hansen's bacillus is absent. The frequent rise of temperature characterizing leprosy does not attend syringomyelia.

Though both diseases progress slowly, the active symptoms—headache, paresis, neuralgic pains—appear earlier in the former, while the dermal, muscular, vasomotor, and skeletal morbid changes do not appear in the regular order, as they do in syringomyelia. The hands and feet are first involved in leprosy; in syringomyelia the proximal parts of the limbs are first attacked and the destructive process is less marked.

Case of a woman 56 years of age who attracted considerable public attention on account of being a supposed leper. Further investigation, however, showed that the areas of erythema and the generalized anesthesia were a neurosis, due probably to locomotor ataxia, from which she was found to be suffering. Troitskoia (Roussky Vrach, Aug. 11, 1912).

Ainhum.—Though Zambaco considers that etiologically ainhum and leprosy may be identical, their clinical aspects are sufficiently dissimilar to prevent errors in diagnosis. Ainhum occurs exclusively in negroes, and consists in the amputation of the little toe by an adventitious fibrous band. Hansen's bacillus has never yet been found in the diseased tissues.

Tuberculosis.—From this disease leprosy is differentiated mainly by the bacillus and through the absence in tuberculosis of anesthetic areas. The injection of tuberculin may, according to Babès and Kalindero, assist in the differentiation. In tuberculosis the general reaction, after the injection of tuberculin, begins about six hours after inoculation; in leprosy it generally comes on twenty-four or, less frequently, in twelve hours after inoculation.

Syphilis.—The course of this disease usually serves to facilitate diagnosis, while Hansen's bacillus is not to be found. Fournier states that general or local analgesia and anesthesia are frequently observed in syphilis; he found, however, that, if present at all, they occur on the dorsal surface of the metacarpal portion of the hand. The Wassermann reaction is frequently obtained in the tuberculous type of leprosy.

The writer employed the Wassermann reaction in 60 cases of leprosy and found that a positive Wassermann reaction was frequently obtained in cases of leprosy giving no history or symptoms whatever of syphilis. The reaction is at times very strong, inhibition of hemolysis being complete. The reaction occurs chiefly in the tuberculous and mixed forms of the disease, especially in advanced and active cases. Fox (Amer. Jour. Med. Sci., May, 1910).

The writers made 48 Wassermann reactions in leprosy. They have found that the reaction is positive in tuberculous leprosy (88.8 per cent.); in the mixed form of leprosy it was positive in 75 per cent., while patients with anesthetic leprosy gave a positive reaction in 16.6 per cent. Montesanto and Sotiriadès (Presse méd., Aug. 31, 1910).

ETIOLOGY.—That leprosy is but slightly contagious is the opinion of the great majority of dermatologists. Not only have repeated inoculations failed to give rise to the disease, but cases have been reported showing that a person may reside with a leper, sleep and eat with him, nurse him, handle and wash his linen, and even wear his clothes with impunity.

In spite of the general diffusion of the disease, those who know most about it doubt its contagiousness. In numerous mixed marriages coming under the personal observation of Zambaco the disease has never been transmitted from one party to the other. Often a single member of a family is a leper, and yet mingles without restraint with the others, adults and children. Nurses and attendants in leper hospitals, often religious devotees, care for lepers and live in their midst for years without contracting the disease.

An analysis by Chew of 1034 cases of leprosy in every stage of the disease showed that not a single case could be traced to contagion, such as sleeping with, eating with or nursing a leper, and handling or wearing his clothes.

It may safely be said that the word "leprosy" strikes more terror into

the heart of its victim, or suspected victim, and also into the mind of the average layman, or even physician, than that of almost any other disease known; and yet, to those who are really well informed, it bears no comparison to either cancer or tuberculosis in the mental distress which it should cause in those afflicted, while syphilis and many other diseases should inspire far more dread of contagion. L. D. Bulkley (Med. Rec., July 10, 1909).

Still, there is considerable testimony in literature tending to prove that leprosy is contagious under certain circumstances, as will be shown under PROPHYLAXIS. Observers who have had occasion to study large numbers of cases generally uphold this opinion.

The history of the disease in all countries, and among every class of people, points to the certainty of contagion. It has been traced to sources. Its course has been progressive when segregation has not been enforced, and retrogressive when it has. In proportion to the failure to carry out segregation, the disease has advanced. Families which in England are and have been free from the taint of leprosy go to China, or elsewhere where leprosy prevails, and become leprous. Dressers, nurses, and physicians in leper hospitals contract the disease quite frequently. To Louisiana the disease came with some French settlers; to New Brunswick with Frenchmen; to Minnesota with Norwegians, and so on. In each location where the disease develops carriers had come from leper-infected places. E. S. Goodhue (Med. Record, Jan. 27, 1900).

In the Hawaiian Islands kissing and nose-rubbing, which are the native forms of salutation; cohabitation, and the reception of the secretion of lepers through abrasions of the skin are considered as causes of communication. The natives eat *poi*, or *pa'ai*, as well as other kinds of food, with their fingers, from the same dish. Worse than this they make the native drink, called "*awa*,"

by masticating *ti* or *ki* leaves, and depositing the pulp into an earthen jar, where it is allowed to ferment, after which they drink it as an intoxicating beverage. The opinion generally prevails among physicians and the more intelligent classes of people on the island that leprosy is very frequently communicated by sexual intercourse. There is no reason why this should not be the case, as we know that abrasions of the mucous membrane are among the earlier manifestations of the disease. The mosquito, house-fly, and other insects have been accused of being carriers of the disease. C. E. Davis (Albany Med. Annals, Feb., 1901).

In a study of the histories of 10,000 cases in the Culi6n Leper Colony, the writer found that 29 per cent. of the lepers gave definite histories of contact with leper relatives. In only 1 per cent. had infection been transmitted through marriage. Denney (Jour. Amer. Med. Assoc., Dec. 29, 1917).

Clinical evidence tends to demonstrate that leprosy is not hereditary in the true sense of the word (though a fetus may be infected by a leprous parent and be leprous at birth), but that a proclivity to the disease is inherited by the offspring, and that exposure, in his case, will lead to its development.

In his investigation of 1034 lepers Chew noted that, of these, 10 were born leprous; 21 contracted leprosy from their parents before puberty. The disease skipped the first generation to attack the second in some, and the third in others. There were 15 that were born leprous of healthy parents.

Conditions capable of sufficiently reducing the vital resistance of the organism—insufficient or unwholesome food, excessive use of salt, a fish diet, exposure to cold and damp, alcoholism, malaria, overwork, syphilis, tuberculosis, etc.—are recognized predisposing factors.

According to Jeanselme and Laurens, and Sticker, lepers eliminate the bacillus of leprosy in enormous numbers through the upper respiratory tract and particularly the nasal cavities. During the active

stages of the disease the nasal secretions and the sputa of the subjects thus disseminate the bacillus of leprosy, by emptying their nostrils and expectorating over the restricted grounds in which they are segregated.

The telluric origin of leprosy would thus find an explanation. Though but slightly communicable by the leper himself when free, his compulsory segregation within a certain area of ground would thus cause him to transform this area into a focus of infection. His sputum, nasal secretion, and other contaminated ejecta would play the rôle in leprosy that the sputum plays in the propagation of tuberculosis.

A subject predisposed by heredity or debilitating factors could thus become infected in various ways by dust or water contaminated with secretions containing Hansen's bacilli. The upper respiratory tract is particularly exposed to infection through dust inhaled.

The breath of the patient, especially during the act of sneezing, has been found charged with bacilli, and the air so charged may come into contact with the nasal mucous membrane of persons in the immediate vicinity.

Experiments showing that very great numbers of bacilli were given out in sneezing,—in one instance more than 110,000. Conclusion that in lepers in whom there is an affection of the mucous membranes of the air passages, not necessarily of an extreme grade, thousands of bacilli are thrown out to a considerable distance in speaking, coughing, and sneezing, and that this dissemination cannot be prevented by therapeutic measures. Dissemination of the bacilli from the upper air passages is relatively the most important of the various ways of infection. Schäffer (Archiv f. Derm. u. Syph., 1898).

It is probable that the mouth and nasal cavities are the avenues of entrance of *Bacillus lepræ*. Leprosy is contagious, but not hereditary. Hansen (Monats. f. prak. Derm., B. 25, No. 9).

The statement of Sticker, who had found the bacillus in the nasal secre-

tion in 83 per cent. of the patients examined, confirmed. Personally examined 142 cases with this object: 50 with nodular leprosy, and 92 with maculoanesthetic symptoms. The bacillus was discovered in 50 cases, 46 of which belonged to the nodular type and 4 to the anesthetic. Nearly all nodular lepers throw out large quantities of bacilli by the mouth in the act of sneezing or talking loudly, but this occurs more rarely during ordinary conversation. Bacilli were not found as a result of forced expiration. Lie (Brit. Med. Jour., Jan. 26, 1901, from *Lepra*, vol. i, Fasc. 1 and 2).

Patient with leprosy whose nasal secretions swarmed with *lepra* bacilli. The man ascribes the infection to cleaning a building in Colombia, South America, which had been used at one time for lepers, but was then empty. A few months later symptoms of leprosy developed. J. Courmont, M. Launois, and Dufourt (Bull. de l'Acad. de Méd., Apr. 26, 1910).

Abrasions and solutions of continuity of the skin or mucous membrane, etc., may thus also afford an entrance to the specific germ.

Morrow advanced the theory that, like syphilis, leprosy was usually communicated by sexual intercourse. In Chew's statistics but 7 cases out of 1034 can be traced to coitus; but, as already stated, the period of incubation of the leprosy is long and the disease may thus frequently be communicated and show signs of its existence long after intercourse. Hansen's bacillus has been found in semen.

Sex does not seem to have much influence upon the development of the disease, though male lepers are by far the more numerous. It may attack children as well as adults, but it is most frequently met with in persons between 20 and 45 years of age: the period of life attended by the greatest exposure.

The bedbug has been found to harbor the specific bacillus and capable of transmitting the disease in animals. It may prove to be one of the factors in the transmission of leprosy.

Leprosy found 14 times by the writer in an examination of 2780 rats. The pathological condition was much as observed by others, thickening of the skin, nodules in 1 case only, but ulcers in nearly every case containing enormous numbers of the acid-fast bacilli, morphologically identical with those of human leprosy. Agnes Walker (Jour. Amer. Med. Assoc., Oct. 3, 1908).

Having found acid-fast bacilli answering as far as our imperfect tests permit to the characteristics of lepra bacilli in a considerable proportion (about 30 per cent.) of specimens of *Acanthia lectularia*—a bedbug—up to sixteen days after feeding on lepers, this species of insect may constitute a very important agent in the spreading of leprosy. T. L. Sandes (Brit. Med. Jour., Sept. 2, 1911).

A total of 105 bedbugs fed on lepers, and 35 caught in the beds of lepers, and examined for leprosy bacilli, gave no evidence that these insects harbor or transmit the disease. Thomson (Brit. Med. Jour., Oct. 4, 1913).

Bedbugs can be induced to take up lepra bacilli with blood to which the bacilli have been added. Within the bugs the bacilli for a time increase in size and apparently in numbers; but they eventually disappear, partly by discharge with fecal matter, partly also by disintegration within the bedbugs. In the bugs thus infected the writers found the bacilli in the glands as well as in the alimentary canal. Bedbugs acquire lepra bacilli also with blood taken from human leprosy subjects, but not invariably. The bugs infected in the laboratory—presumably more heavily infected than those which are infected from human beings—were found capable of transmitting the bacilli by route of their sucking apparatus to the skin of animals bitten. Smith, Lynch and Rivas (Amer. Jour. Med. Sci., Nov., 1913).

Hansen's bacilli have been found in bedbugs and horse flies, while both the flea and mosquito have been accused of transmission on clinical evi-

dence. Evidences of direct contagion, on the other hand, are not convincing in comparison with the data which point to some sort of mediate contagion. In regard to hereditary transmission leprosy never descends as such, but abortion and bearing of inferior children are commonly observed in leprosy women. Chabas (Chronica Medico-Quirurgica, July, 1918).

DISTRIBUTION.—Leprosy is most prevalent in India, where, according to Zambaco, there are 130,000 cases; but the disease is thought to be increasing. It is also met with extensively in China; but less so in Persia, Japan, Tonquin, Siam, Anam, the Antilles, and South America.

Plumacher estimates that there are 30,000 lepers in the departments of Boyaca and Santander, in Colombia.

Leprosy also exists in Norway, Sweden, Russia, Spain, Italy, Roumania, Greece, Turkey (at least 4000), and in a modified and light form in France.

In the English-speaking sections of North America the cases are comparatively few. There are 5 foci, 2 in Canada, aggregating about 40 cases, and 3 in the United States, aggregating about 300 cases. Dyer, at the Berlin Leprosy Conference, reported that there were 126 cases in Louisiana. Wisconsin and Minnesota are computed to contain about 150, all among Swedes and Norwegians. In the Hawaiian Islands, according to Morrow, there are about 1200 cases at Molokai. Sporadic cases are occasionally met with in our cities. As previously stated, it is believed that leprosy is increasing in the United States.

The actual prevalence of the disease cannot be accurately stated. The latest statistics obtained by correspondence give a total of 146 in the continental United States, but this is probably not complete, as it is notifiable in only 18 States and in the District of Columbia and the outlying territories. It is evident that it is widely distributed at the present time, though the total number is trivial, and it is of national importance by reason of such distribution and the numerous possible foci of

infection. Rupert Blue (Jour. Amer. Med. Assoc., Sept. 20, 1913).

PATHOGENESIS.—A specific bacillus closely allied to the bacillus of tuberculosis has been shown by Hansen in 1871 to be the exciting cause of leprosy. The labors of Neisser have confirmed Hansen's discovery. *Bacillus lepræ* is a long and slender, motionless rod, with slightly tapering ends. It reacts in the same way that the tubercle bacillus does to coloring reagents, but much more readily—a distinctive feature—and takes aniline dyes, which tubercle bacilli do not. Again, the bacilli of leprosy are usually much more numerous.

The researches of the last twelve years have only more firmly established the lepra bacillus of Hansen as the specific cause of leprosy. During the last decade numerous attempts have been made to cultivate the bacillus, but no medium has been discovered on which it will invariably grow. It has not been proved that the bacillus is present and can lead a saprophytic existence on decayed organic matter, such as decomposed fish, meat, rice, or in the soil. J. M. H. Macleod (Brit. Jour. of Dermat., Oct., 1909).

The results of animal experiments demonstrate the fact that direct communication of the disease may take place from individual to individual without the presence of the bed-bug or other parasites as intermediate hosts. In the examination of blood from patients suffering from leprosy the serum has been shown to contain specific antibodies of different kinds against certain constituents of *Bacillus lepræ*. In addition to the presence of specific bodies, they have demonstrated that complement is present in normal quantities. Agglutinins are present, though not in very large amounts. The opsonic content is probably affected at different stages of the disease. Duval and Gurd (Arch. of Intern. Med., Feb., 1911).

The acid-fast bacillus known in the human leprous lesion as the Hansen organism can be cultivated *in vitro*

under special nutritive conditions. The initial multiplication away from the tissues of the host occurs in the presence of the split products of animal protein, the amino acids, and under no other conditions. Duval and Harris (Jour. Med. Research, May, 1913).

Arning thought he had successfully inoculated a condemned criminal with matter obtained directly from a leper, but the subject was subsequently found to belong to a family (including his son and nephew) in which the disease existed: a fact demonstrating his proclivity to the disease. More recently, however, leprosy has been produced in the monkey.

The writer succeeded in producing leprosy in the monkey (*Macacus rhesus*). Four injections at intervals were followed by the formation of hard, nodular masses that slowly increased in size, and the skin about which showed numerous small, indurated areas. On rupturing, one of the masses discharged a grumous material, which, on microscopic examination, was found to contain large numbers of leproid cells filled with acid-fast bacilli. Cultures prepared from this material remained sterile with respect to pyogenic microorganisms; however, *Bacillus lepræ* was recovered in pure culture upon special artificial media.

Forty-six days after the first injection the monkey showed typical signs of disseminated infection, and presented the clinical picture of human leprosy of the tuberculous type of the disease. C. W. Duval (Univ. of Penna. Med. Bull., Feb., 1911).

Occurrence of leprosy in a monkey in which the disease developed thirteen months after the first, and nine months after the last, injection of a pure culture of *Bacillus lepræ*, the infection being identical in symptom-complex with that in man, and terminating fatally. Duval and Couret (Jour. of Exper. Med., Mar., 1912).

The introduction of the virus through abrasions, scarification with medicinal

substances, and vaccination, which together represented almost one-fourth of the etiological factors noted by Chew in his 1034 cases, demonstrates that transmission by inoculation is, in reality, an important pathogenic factor.

The bacilli are to be found in all the tissues and liquids of the diseased areas only, and particularly in the lepromata.

The blood of lepers in various stages of the disease was carefully studied by Winiarski. When leprosy has not given rise to great changes in the organism, the composition of the blood is not much altered. No change in its composition in the various forms of leprosy (anesthetic, nodose, and mixed) could be demonstrated. In chronic cases the number of blood-corpuscles was always found to be diminished, on an average, 17.9 per cent. in men and 12.3 per cent. in women. The hemoglobin was decreased, on an average, 6.3 per cent. in men and 2.4 per cent. in women. The white blood-corpuscles were usually normal in quantity. In all cases of leprosy a large preponderance of multinuclear leucocytes was noted. The bacillus is readily found.

After satisfying himself of the diagnostic value of Rosenberger's method of demonstrating the tubercle bacillus in the circulating blood, the writer began an examination of the blood of the patients in the leper colony here in Guam. The technique used is practically that of Rosenberger. Sixteen cases were examined. In 15 the blood contained a bacillus which morphologically and in staining reactions is identical with the lepra bacillus. Crow (U. S. Naval Bull., Apr., 1910).

The pathological changes in the bones in leprosy occur in three different ways: 1. The true trophic disturbance due to the altered innervation, in which there takes place a simple atrophy or gradual absorption of the bone. 2. An osteomyelitis or periostitis caused by the lepra bacillus. 3. A necrosis or inflammation of either of the above arising from secondary involvement by pyogenic organisms. Herrick and Earhart (Arch. of Intern. Med., June, 1911).

Bacillus lepræ is easily found in the blood in cases of leprosy. The method consists in collecting 0.1 to 1 c.c. of the patient's blood from the tip of the finger or toe (free from lepra lesions), or from the vein, in about 5 to 20 c.c. of a 2 per cent. solution of acetic acid in which the erythrocytes are dissolved. The mixture is centrifugated for about fifteen minutes and the sediment examined for alcohol acid-fast bacilli. The method of staining is one usually followed in the examination for tubercle bacilli; the sediment is spread on a slide, dried, fixed, stained with carbol-fuchsin, decolorized with 30 per cent. hydrochloric acid solution in 95 per cent. alcohol, and counterstained with methylene blue. Damaso Rivas (N. Y. Med. Jour., Jan. 25, 1913).

Investigations showing that lepra bacilli circulating in the mother's blood can be transmitted to the fetus in utero through hematogenous channels. M. Rabinowitsch (Berl. klin. Woch., Feb. 10, 1913).

That segregation is an effective prophylactic measure for the protection of the public at large against leprosy is undoubted. The same statement would be applicable, however, were syphilitic, tuberculous, and other infectious subjects to be compulsorily isolated and ostracized from society. Indeed, it would apply more forcibly, since all the evidence at our disposal tends to prove that leprosy is one of the least contagious of infectious diseases, though undeniably so in predisposed individuals.

The bacilli of leprosy are only found in diseased tissues and in the blood, discharges, etc., of the latter. It is a question, therefore, whether the healthy areas of skin and mucous membrane are not subject to reinfection from external cause (see ETIOLOGY) capable of inducing the disease in any predisposed subject.

Segregation within a restricted district under such circumstances would greatly compromise the chances of recovery of the sufferers so segregated. Constantly exposed to contaminated soil and surroundings, reinfection would seal the doom

of many who, under the influence of hygienic surroundings, would be restored to health by appropriate treatment. Lazarettos, pest-houses, etc., would thus become foci of infection.

This is strongly sustained by the fact that in such institutions practically all the patients die of the disease or its complications, while, among lepers only exposed to the average contaminating influences of cities, many are saved.

Of 1034 cases of leprosy observed during a period of fourteen years and nine months by Chew, 422 were cured, while medicines failed to make any lasting impression on the remaining 612.

According to Morrow's computation, the number of lepers in the Molokai settlement (Hawaii) averaged, at the time, about 1200, but he contends that, notwithstanding the optimistic view of the health authorities that leprosy is on the decrease, the annual consignment of lepers to the settlement shows but little, if any, diminution. "All the indications point to the existence of a vast deal of latent leprosy, which, as the disease develops into a recognizable form, must continue for many years to come to furnish a constantly recurring series for the leper colony."

What probably does exist in Hawaii is a large number of vulnerable individuals, vulnerable through the operation of the various factors enumerated, and especially active, in our new possession, on account of the deteriorated state of the natives. These etiological factors, as well as susceptible subjects, are to be found in all countries and especially in districts where poverty, filth, bad food, and alcoholism prevail. Were compulsory isolation abandoned, therefore, leprosy—like syphilis, tuberculosis, cancer, etc.—would assume the position of a general disease, its development being commensurate with its low degree of contagiousness and the hygienic level and customs of the communities exposed. In the United States the debilitating influence of excessive and unduly prolonged physical and mental activity would tend to increase vulnerability, and the dissemination of leprosy might thus be greatly enhanced.

Segregation of lepers is, therefore, im-

perative, but only on the condition that they be compensated for their isolation on behalf of others by adequate protection against continued infection and by the most conscientious efforts to restore them to health and to their families.

In some "settlements," "lazarettos," or "pest-houses" these unfortunate *patients* (some of which may not be leprosy and be suffering from tuberculosis, syringomyelia, or syphilis) are practically assimilated to criminals awaiting the death penalty, while neglect, both general and professional, is insidiously acting as executioner.

Such neglect on the part of municipalities—such wretchedness—is not compatible with modern civilization. Sanitary regulations to protect communities involving the sequestration of innocent sufferers should not destroy with one hand to save with the other. All should come in for their share of the benefits, if equity is to prevail and if the cruelties of the dark ages are not to be perpetuated. Consumptives, inebriates, the insane, etc., enjoy all the advantages of well-appointed and comfortable sanatoria; so should the leper receive his share of all that human compassion can afford to relieve him of physical sufferings and of the mental torture that ostracism entails.

A sanatorium for lepers should, in the light of our present knowledge, and in keeping with settlements under United States authorities, be conducted much on the same lines as one for consumptives: scrupulous cleanliness, pure air and sunlight, *strict attention to the destruction by fire or antiseptics of all substances containing bacilli*, especially the secretions of the mouth and nose and the discharges originating from tuberculous nodules. With abundant wholesome food, comfortable surroundings, distraction, and constant professional care, the lives of these victims could be made bearable; the fetters which sanitary rulings impose upon them would hardly be felt, and many would be returned to their homes.

As to the immigration of lepers into the country, Dr. Bracken, of Minneapolis, basing his opinion upon a study of the Minnesota colony, suggests that the family history of all immigrants from a country

where leprosy prevails should be secured before they are allowed to embark for America, no member of a leprous family being permitted to land upon our shores. This procedure would doubtless prove effective were it properly carried out; but, as shown by Hansen, who recommends the same measure, the symptomatology of the disease in its early stages and the necessity of examining the entire body of each passenger would defeat any attempt in this direction from the start.

Germany, by recent legislation, has very judiciously placed leprosy on the list of those requiring compulsory declaration, urging the necessity for a constant watch that the disease be not allowed to get a foothold in the country. Blaschko (*Deut. med. Woch.*, Dec. 23, 1909).

TREATMENT.—If, as held by Morrow, Hansen, Sticker, and many others, "the vehicles of the virus through which contagion is affected in the vast majority of cases are the secretions of the mouth and nose," while "the port of entrance is the mucous membrane of the respiratory and intestinal tract with secondary infection through the blood or lymphatic system" (Morrow), attention to the nasal cavities, the mouth, and throat is of primary importance.

The normal secretions of the nasal cavities are alkaline and of a higher specific gravity than water; hence, the use of the latter as detergent is painful and irritating to the mucous membrane. Any liquid used for this purpose should at least possess the alkalinity and specific gravity represented by 1 dram (4 Gm.) of common salt to 1 pint (500 c.c.) of water. As a wash, the following mixture can be confidently recommended after extensive trial in disorders of the upper respiratory tract:—

R Borate of sodium,
Bicarbonate of sodium . . . of each 3ss (2 Gm.).
Fluidextract of
Canadian pine .. f3j (4 c.c.).
Glycerin f3ij (8 c.c.).
Water Oj (500 c.c.).—M.

This may be used with an atomizer producing a coarse spray night and

morning, the cavities being thoroughly drenched. In large colonies under municipal management borax and bicarbonate of sodium, equal parts, may be procured in bulk and dealt out to patients with instructions to use 1 teaspoonful of the powder to a pint of lukewarm water. An economical way is to inhale the solution from the hand, using the latter as scoop. When ulceration is present, the local treatment for syphilitic rhinitis (*q. v.*) is indicated. The secretions, as already stated, should be destroyed, and the use of spit-cups rigidly enforced.

Segregation where lepers have previously lived without resorting to such precautions should be avoided.

Cleanliness of the surface should be carried to the maximum possibility compatible with the patient's strength. As a curative measure, Baelz, of Tokio, recommended 3 to 5 strong mineral baths at 45° to 53° C. a day for a period of about one month. His results were excellent. Sea-bathing was extensively used, and with marked advantage, during the early part of the century. At first warm seawater baths were given, until all "scaly incrustations" were removed; after this "a cure was soon obtained, especially in young persons, by bathing in the open sea."

Eucalyptus in leprosy was advocated by Hollman, who for two years used it with considerable success both internally and by means of baths. Under this treatment the glandular elements of the skin appeared to be stimulated, the integument got softer and more pliable, the facies leontina became less marked, the neuritic pains were much improved, the abscesses of the skin and mucosæ healed, and the fever decreased. Two hundred and seventy-five patients were treated during the two years; all were helped, and all had had leprosy for from five to twenty years. Gottheil (*Prog. Med.*, Sept., 1910).

The writer's treatment consists in local application of liquid carbonic acid, followed by ointments containing pyrogalllic acid and sulphur; oil of gynocardia was given daily by the mouth and by injection. Unna

(Ann. de dermat. et de syph., Oct., 1910).

The writer reports 3 cases in which the use of **guaiacol**, both internally and externally, gave good results. Internally it was given in the form of pills, each containing 0.1 Gm. ($1\frac{1}{2}$ grains) of guaiacol, 0.04 Gm. ($\frac{3}{8}$ grain) of **eucalyptol**, and extract of licorice. The dose was 2 pills morning and evening, gradually increased until 10 pills were being taken daily. Externally the guaiacol was applied with a brush, and sometimes covered with a dressing of gauze and cotton. The drug is rapidly absorbed and appears in the urine ten minutes after application. It exerts a prompt healing effect on the lesions. A **generous diet** is to be combined with this treatment, and an **alkaline bath** given twice a week. N. Maldaresco (Semaine méd., Jan. 18, 1911).

Among the internal remedies recommended by dermatologists, **chaulmoogra oil** may be said to hold the first place. The results obtained from its use have been varied, but, assisted by the prophylactic measures outlined above, its usefulness will probably be vastly increased. It has been administered in doses of from 10 to 200 drops. By beginning with small doses and gradually increasing the quantity given, the gastric disorders occasionally following its use may generally be avoided or at least retarded until active benefit is procured. It is borne more easily by lepers than by healthy subjects, and its use can be continued years, if need be. Many cases have been reported in which permanent cure had been obtained.

The writer's experience with **chaulmoogra oil** is that it almost always does some good, yet in his own hands it has been limited to a slight improvement; that improvement has been in the patient's general condition, as a rule, so that he was uncertain whether it was due to the medicine or to the renewed hope of recovery. It could never be looked upon in the light of a cure. J. A. Thompson (Leprosy, Apr., 1908).

Oil of chaulmoogra is best given as a saponified preparation, in keratin-coated pills; the purified oil can also be injected in doses of 1 Gm. (15 grains) three times a week. **Nastin** injected in doses of 1 c.c. (16 minims) gave good results. Great persistence in treatment, even after relief of symptoms, found advisable. Local treatment by **resorcin**, **hydrogen peroxide**, **ichthyol**, **thiosinamine**, etc., and **baths**, also useful. Kupffer (St. Petersburger med. Woch., Nu. 22-23, 1909).

The best remedy, oil of chaulmoogra, is poorly tolerated by the stomach, and the author has devised a formula for injection as follows: Oil of **chaulmoogra**, washed in alcohol, filtered, and sterilized, 1 part; compound oil, 1 part. The **compound oil** is made up of $\frac{1}{2}$ Gm. ($7\frac{1}{2}$ grains) of **guaiacol**, $\frac{1}{4}$ Gm. ($3\frac{3}{4}$ grains) of **camphor**, and 5 Gm. ($1\frac{1}{4}$ drams) each of **petrolatum** and oil of **petrolatum**. A cubic centimeter (16 minims) of this mixture contains about 13 drops of oil of chaulmoogra; it is well borne, causes no induration, and no fatty embolism of the lungs. Jeanselme (Presse méd., Dec. 2, 1911).

At the Robben Island Leper Asylum the writer found that "Jagger's root" cure, thyroid gland, vaccine treatment, preparations of arsenic, and salts of iodine either had no effect at all or were even dangerous. Furthermore, he tried various drugs, among them lead, silver, and quinine; these 3 with no improvement, and **radium bromide** with ultimate local improvement. The last in his list is **chaulmoogra oil**, which, in his experience, is superior to any other known remedy or reputed cure for leprosy, but it has to be used vigorously and for a prolonged period. The oil was administered by mouth in capsules containing 5 drops each, and in some cases for three years. He reports on 27 patients, all with at least slight improvement, many with considerable improvement, and some even with arrest approximating cure. T. L. Sandes

(*Jour. of Trop. Med. and Hyg.*, Mar. 1, 1912).

Among 42 cases of leprosy treated with **chaulmoogra oil** hypodermically, 16 received injections for 10 to 17 months. Of these, 10 were improved and 4 rendered stationary, while 2 progressed. Most cases took the oil by mouth at the same time, and a number had **carbon dioxide snow** applied locally. Weekly injections of 5 c.c. ($1\frac{1}{4}$ drams) of a mixture containing 50 per cent. of the oil seemed about all that was well borne. Larger doses led to persistent infiltration. The oil mixtures were sterilized at 100° C. for 15 minutes. McCoy and Hollmann (*Public Health Bulletin No. 75*, U. S. Public Health Service, Jan., 1916).

Leprosy is treated with the following: **Chaulmoogra oil**, and **camphorated oil**, of each 60 c.c. (2 ounces); **resorcinol**, 4 Gm. (1 dram). Mix and dissolve with the aid of heat on a water bath and filter. In an illustrative case he first injected into the buttocks 2 c.c. (32 minims) of the mixture every 8 days. The dose was at length increased up to 5 c.c. ($1\frac{1}{4}$ drams) every 3 days, then reduced to 2 c.c. (32 minims), and then gradually increased to 10 c.c. ($2\frac{1}{2}$ drams) lately given in alternate weeks. Quicker results are obtained when one can inject into large leprosy deposits or divide the dose in a number of smaller infiltrations. Five cases have been reported as cured and remaining so for over 2 years. V. G. Heiser (*N. Y. Med. Jour.*, Feb. 12, 1916).

As a standard treatment the writers use weekly injections of a preparation which consists of the mixed **ethyl esters** of the acids of **chaulmoogra oil** with 2 per cent. of **iodine** in chemical combination. The amount used starts at 1 c.c. (16 minims) and is gradually increased to a maximum of 4 or 5 c.c. (1 or $1\frac{1}{4}$ drams) for adults. Three times each day, $1\frac{1}{2}$ hours after meals, the patient receives capsules containing the fatty acids of **chaulmoogra oil** with $2\frac{1}{2}$ per cent. of **iodine** chemically combined. The

dosage for the first 15 days is $\frac{1}{8}$ Gm. ($2\frac{1}{2}$ grains) per 100 pounds of body weight 3 times daily; for the second half of the first month, $\frac{1}{4}$ Gm. (5 grains) per 100 pounds; for the first half of the second month, $\frac{3}{8}$ Gm. (10 grains) per 100 pounds; and after that, 1 Gm. (15 grains) per 100 pounds of body weight. This means, for example, that a 150-pound man would get $1\frac{1}{2}$ Gm. (23 grains) per dose or $4\frac{1}{2}$ Gm. (68 grains) per day. Although conclusive evidence is not at hand, it is probable that the oral administration of **chaulmoogra oil** derivatives is of minor importance compared with the injections.

In treating leprosy, it is important to make use of all auxiliary agencies to build up and maintain bodily vigor. Hypodermic injections of the **ethyl esters** into leprosy nodules are followed by marked swelling with ultimate recession of the lesions. This is a valuable auxiliary treatment for especially resistant lesions.

The results of the **chaulmoogra oil** treatment thus far have been so satisfactory that lepers come willingly for treatment, a recent inspection by Hawaiian health authorities failing to disclose a single secreted case of leprosy.

Following a course of treatment extending over about a year, 48 lepers, treated according to the new method, were paroled in October, 1919. McDonald and Dean (*Public Health Reports*, Aug. 20, 1920).

A purified form of **chaulmoogra oil**, **anti-leprol**, is available. It is given in doses ranging from 5 to 50 drops in milk or capsules.

Nastin, a bacterial fat obtained from a streptothrix isolated from leprosy nodules, has been praised. The best results seldom exceed marked improvement.

Of 6 cases treated by **nastin** which had a duration of from five to sixteen years, 5 greatly improved, and 1 was practically cured. **Nastin** has in suitable cases the power of destroying the leprosy bacilli which are present in the organism, and so amel-

iorating the symptoms, or even curing the lesions of leprosy. Max Rudolph (Arch. Brasileiros de Med., vol. ii, No. 3, 1913).

Vaccine therapy, the agent mainly used being **leprosin**, a bacterial product of the leprosy bacillus, seems worthy of extensive trial.

The writer was unable to arrest the progress of inoculation leprosy in a white rat by means of injections of rat **lepra bacilli** killed by heat. Injections of killed bacilli some days previous to the injection of living bacilli resulted in marked delay in the progress of the disease. Wherry (Jour. of Infect. Dis., Nov., 1909).

Twenty-two patients treated with **vaccine**, 5 of whom have practically recovered and 15 have shown marked improvement, while the remaining 2 patients showed neither improvement nor increase.

Improvement is very slow. The anesthetic patients should be given much larger doses of vaccine than the tuberculous ones. Rost (Indian Med. Gaz., July, 1912).

The writer reports marked improvement in 2 cases of leprosy in which he injected **antianthrax vaccine**. He concludes from the results obtained that antibodies fatal to the **lepra bacilli** were produced, specimens from the nasal discharges previously found to contain active bacilli having been found sterile after the injections. Campos (Vida Nueva, Havana, Sept., 1918).

Ichthyol has been strongly recommended by Unna, who gives about 10 grains (0.6 Gm.) of this product a day in divided doses.

Ichthyol soap or the pure drug may also be employed locally. **Pyrogallic acid** and **chrysarobin** have also been recommended by Unna.

Ichthyol, beginning with 30 to 45 grains (2 to 3 Gm.) a day, reaching 2½ drams (10 Gm.) a day in a short time, gave rise to no unpleasant by-effects, and proved effective in the tuberculous form of leprosy. In the

neurotic form it was inefficacious. De Brun (Bull. de l'Acad. de Méd., 1901).

Crocker administers **corrosive sublimate** hypodermically. A Pravaz syringeful of the solution, varying in strength according to age, is injected into the buttocks once a week. **Europhen**, **thyroid substance**, and **salicylic acid** may also be mentioned among the remedies meriting a trial.

In 11 cases of leprosy, 2 of the anesthetic variety, 4 of the tuberculous variety, and 5 of the mixed variety, **hydrargyrum succinimidum**, ⅓ grain (0.013 Gm.), was injected into the buttocks every second day for the first thirty days, then ⅔ grain (0.026 Gm.) every fourth day, to date. In a few instances mild symptoms of mercurialism manifested themselves and necessitated the discontinuance of the treatment for several injections. In no case, however, did this occur until well along in the second month of the treatment. The results of nearly four months' treatment by this method are not encouraging, although in a majority of the cases some improvement of the subjective symptoms has taken place. Angeny (Military Surgeon, Sept., 1909).

Salvarsan has been tried, but it does not seem to influence materially either form of leprosy.

The writer administered a total of 2 intramuscular and 48 intravenous injections of **salvarsan** in 13 typical and active cases of leprosy. Tuberculous leprosy did not seem to be at all benefited, though three months (excepting in 1 case) had almost elapsed since the last injection. The bacilli were, however, distinctly fewer and more difficult to find, as a rule, in smears made after treatment than in those previously obtained. On the whole, the results were not encouraging. T. L. Sandes (Jour. of Trop. Med. and Hyg., Mar. 15, 1912).

In cases where the patient is not too weakened from the disease **salvarsan** may be administered without harm. Some improvement may be expected especially in early cases.

There is no evidence, however, that such effect of the drug is in any way specific or permanent. Creighton Wellman (N. Y. Med. Jour., Nov. 16, 1912).

Tuberculous nodules may be destroyed by **galvanocautery** or **thermocautery** followed by local **antiseptic lotions**. If this procedure is objected to, their absorption may sometimes be obtained by local applications of **iodine** or **mercurial ointment**. Besnier uses with success in tuberculous cases a form of treatment combining several measures.

The most effective method of dealing with the ulcerations met with in tuberculous leprosy is to scrape them and then apply a wash of 5 per cent. **benzoyl chloride** in petrolatum. Wise and Minett (Jour. of Trop. Med. and Hyg., Sept. 2, 1912).

In the large number of incipient cases where the disease is localized (peripheral or neural) any treatment that will remove the circumscribed area or focus of infection, without opening up channels for metastatic dissemination, will effect a cure in from six to twelve months time. The initial focus may remain localized for a time extending from a few months to years, or even a lifetime. E. S. Goodhue (Amer. Med., Mar., 1913).

In a case successfully treated by Besnier in the manner just outlined the patient, unknown to his physician, had also taken for a period of three years **chlorate** of **potassium**, 15 grains (1 Gm.) three times a day.

The **X-rays** have given encouraging results, and should be used before the internal lesions of the disease have developed to any marked degree.

The experience in the Philippines during the past three years demonstrates that **segregation** has decreased the incidence of leprosy by over 50 per cent. Of all the treatments tried the **X-ray** is the only one which produced a cure, but as yet it is suitable only for specially selected cases. Heiser (American Journal of the Medical Sciences, Sept., 1909).

The fractionization of chaulmoogra oil yields, according to Sir Leonard Rogers (Brit. Med. Jour., Oct. 21, 1916), several different portions, that of the lowest melting point yielding fatty acids, the sodium salts of which are readily soluble in water, and only moderately irritant. The sodium salt, **sodium gynocardate**, which forms the greatest proportion of those present, may be given intravenously to man in leprosy in the form of a 2 or 3 per cent. solution to which $\frac{1}{2}$ per cent. **phenol** has been added, sterilizing in an autoclave. Doses of 6 to 50 mg. ($\frac{1}{40}$ to $\frac{1}{10}$ grain) have been given to man without any toxic effects, although there often follows a definite local reaction and sometimes fever. The tissues soften and nodules, if present, diminish in size. Such results are not obtained from its subcutaneous use. The writer has treated 20 cases; when it was possible to carry out the treatment a sufficient time, there was very marked improvement with healing and disappearance of local lesions; disappearance from open lesions of the bacilli; return of sensation in anesthetic areas and restoration of function in paralyzed parts.

C. E. DE M. S.

LEPTANDRA.—Leptandra (veronica; Culver's root) is the rhizome and root of *Veronica virginica*, a plant of the family Scrophulariaceæ. It contains a bitter principle known as leptandrin, as well as saponin, tannin, resin, starch, etc. Leptandrin as sold is an impure resin or alcoholic extract.

PREPARATIONS AND DOSE.—*Leptandra*, N. F. (leptandra). Dose, 15 grains (1 Gm.).

Extractum leptandræ, N. F. (extract of leptandra). Dose, 4 grains (0.25 Gm.).

Fluidextractum leptandræ, N. F. (fluidextract of leptandra). Dose, 15 minims (1 c.c.).

PHYSIOLOGICAL ACTION.—Leptandra is classed among the drastic cathartics, though its action is mild and slow as compared with that of colocynth and jalap. Like several other cathartics, leptandra has been credited with cholagogue properties.

THERAPEUTICS.—In indigestion with deficient secretion and constipation, lep-

tandra is useful, combined with podophyllum or with aromatics. When stools are clay-colored, showing a deficiency of bile, this agent will, according to some, bring about bilious discharges, even when there is diarrhea. The extract of leptandra is an eligible form for administration in small doses where merely a laxative action is desired. The root of leptandra should be dried for clinical use, when fresh its action is too violent. W. and S.

LEUCINURIA AND TYROSINURIA.

Leucin ($C_6H_{13}NO_2$) and tyrosin ($C_9H_{11}NO_3$), related decomposition-products of proteids, usually occur together in the urine and in the organism itself. When retrograde tissue changes are rapid, as in extensive supuration and gangrene, they form in large amounts and pass into the urine, largely supplementing urea. They also occur in the urine in acute atrophy of the liver, acute phosphorus poisoning, and at times in leukemia, typhoid fever, and variola. Leucin is normally present in the liver, pancreas, spleen, lymph glands, salivary glands, and thyroid and thymus glands.

Detection of Leucin.—*Microscopical examination* of a urinary sediment containing leucin will reveal it in the form of yellowish, highly refractile spheres, resembling oil-globules. When pure it crystallizes in scales or rosettes, often of irregular shapes, and has a greasy feel. It is insoluble in ether, thus differentiating it from oil-globules and in mineral acids; it is partly soluble in water and alcohol, and completely in caustic alkalis. Chemical tests are confirmatory if enough leucin is available.

Hoffmeister's Test.—Heating the solution with mercury protonitrate yields a deposit of metallic mercury.

Scherer's Test.—When evaporated with nitric acid on platinum-foil leucin leaves a colorless residue which, if heated with potassium hydroxide, forms drops of an oil-like fluid which does not adhere to the platinum.

Sublimation Test.—Leucin heated in a glass tube open at both ends to about 348° F. (170° C.) sublimes in feathery particles. Further heat fuses it, and causes it mostly to disappear.

Separation Test.—Evaporate the urine, and dissolve the residue in boiling alcohol. When cooled the leucin will be deposited in whitish plates or masses. S.

LEUCODERMA.—DEFINITION.

—Leucoderma (vitiligo; achromia cutis; acquired leucoderma; acquired piebald skin; pigment atrophy) is an affection characterized by variously sized and shaped whitish patches, usually surrounded by abnormally pigmented borders.

SYMPTOMS.—This disease appears as rounded, oval or irregular, milk-white or pinkish-white spots which spread more or less rapidly, coalescing at times to form large patches. These patches are smooth, soft, sharply defined and level with the surrounding skin surface, which latter is the seat of increased pigmentation, usually brownish yellow in color. The hairs in the affected area may turn white, especially if the patch extends into the hairy scalp. When exposed to the sun, especially during the summer, the pigmentation around the patches is augmented, thereby increasing the disfigurement. Slowly progressing, the disease becomes conspicuous after a few years. The greater part of, or, indeed, the whole, body may become involved. Leucoderma generally persists during life. The favorite seat of the disease is the back of the hands, the neck, face, and the trunk. Subjective symptoms are absent.

DIAGNOSIS.—Leucoderma must be differentiated from chloasma, tinea versicolor, morphea, and leprosy. In chloasma the patches are brownish yellow; there are no white spots. In tinea versicolor the patches are brownish yellow, covered by furfuraceous scales; this is caused by a fungus. In morphea there is a thickening of the patch at first, which is followed by atrophy. In leprosy the patches may be whitish or yellowish, but the surface is anesthetic.

PROGNOSIS.—The disease is practically incurable, although in a few rare cases spontaneous recovery has occurred.

TREATMENT.—Though the treatment is highly unsatisfactory, a cure has been reported from the use of **thyroid extract**. Duhring advised small doses of **arsenic**, long continued. Lotions of **mercury bi-**

chloride or of acetic acid may be applied locally to the pigmented borders. W.

LEUCORRHEA. See VAGINA AND VULVA, DISEASES OF.

LEUKEMIA AND PSEUDO-LEUKEMIA, OR HODGKIN'S DISEASE.

LEUKEMIA, OR LEUCOCYTHEMIA.

DEFINITION.—A disease of the hematopoietic system, usually chronic, insidious in onset, and characterized by a very great increase in the number of the leucocytes, with marked alteration of the leucocytic formula. There are two types—the myeloid and the lymphoid.

MYELOID LEUKEMIA.

SYMPTOMS.—The onset is insidious and it is probable that by the time symptoms attract the attention of the patient the disease is far advanced. In practically all cases in which the blood was examined at the time the patient first came under observation the picture revealed was that of a fully developed leukemia. A physician is first consulted, as a rule, because of pain in the left upper quadrant of the abdomen in association with a mass, which on examination is found to be the spleen. Less commonly, severe nosebleed or hemorrhage from some other part of the body is the first evidence of the disease. In most cases, however, if a careful history is elicited it will be found that for weeks or months, or perhaps longer, the patient may have experienced a vague sense of ill health with later loss of appetite, an increasing tendency to fatigue, and loss of weight. These symptoms may remain stationary or abate, only to recur.

As the disease progresses, dyspnea

becomes troublesome, even before marked anemia occurs, and is due to the crowding of leucocytes in the capillaries of the lungs. In the terminal stage of the disease anemia becomes marked, giving rise to pallor, vertigo, headache, and edema of dependent parts. Dyspnea increases.

Fever is present in every case. It is irregular in type and for a time may be absent. The temperature is usually under 102° F. (38.9° C.). Preceding death there may be either a rise or fall in temperature. Tenderness on pressure or even pain may be felt by the patient over the sternum and the shafts of the long bones. Hemorrhage is common later in the disease. It may be slight or severe and may occur from any of the mucous membranes, or into various organs, including the brain. The amount of blood lost may be lethal.

Early in the disease slight or moderate enlargement of the spleen may be the only abnormality detected. Later the spleen becomes huge and may extend into the pelvis. It is usually firm, smooth, and not movable. The normal contour is preserved and the notch or notches may be readily felt. Sometimes pain on pressure is elicited, and auscultation may reveal a friction synchronous with the respiratory movements of the diaphragm. Variations in the size of the spleen may occur during the course of the disease. After hemorrhage or during the course of an intercurrent infection marked diminution may be observed. Hemorrhage into the spleen may cause a sudden enlargement.

The liver is almost always increased in size, extending 1 to 4 fingers' breadth below the costal margin, or even below the transverse umbilical

line. It is smooth, firm, and regular in outline. Usually it is not painful and only occasionally is tenderness complained of on pressure.

The heart may be displaced by upward pressure of the enlarged spleen. The muscular element of the first sound is diminished and a soft systolic murmur at the apex may be heard.

Usually, the second sound at the pulmonic cartilage is accentuated. Percussion over the chest posteriorly may reveal dullness due to compression of the base of one or both lungs. Unilateral or bilateral pleural effusion may be found, and when unilateral it is most commonly present on the left side.

The peripheral lymphatic glands are rarely enlarged.

Uric acid is present in the urine in a larger amount than is the case in any other disease. It is derived from the nuclei of the disintegrated leucocytes. Very interesting and suggestive is the fact that muscle and joint pains are usually absent, notwithstanding the very large amount of uric acid found in the urine. Albumin may or may not be present. It may appear irregularly during the course of the disease, particularly during febrile periods. Casts, usually of the hyaline variety, may be found from time to time.

Blood.—The characteristic changes consist in the great increase in leucocytes and the appearance in large number of myelocytes, the latter being the distinguishing feature of the myeloid type of leukemia. The leucocytes usually number from 100,000 to 500,000 per c.mm.; less commonly more than 1,000,000 white cells per c.mm. are counted. The ratio between leucocytes and erythrocytes,

instead of the normal 1:500, is usually 1:10. Later, as the number of leucocytes increases and erythrocytes decrease, the ratio may be 1:1. Cases have been reported in which the leucocytes exceeded the erythrocytes in number.

Case of acute lymphatic leukemia in an infant in which the count reached 1,330,000. This is the highest leucocyte count which the writer has been able to find on record in lymphatic leukemia in childhood. Veeder (*Archives of Pediatrics*, Jan., 1911).

A very marked alteration occurs in the leucocytic formula. The polymorphonuclear cells make up about 30 to 60 per cent.; small lymphocytes about 1 to 5 per cent.; large lymphocytes 3 to 30 per cent.; eosinophiles 1 per cent.; myelocytes 30 to 50 per cent. All the leucocytes normally found in the blood are much increased in actual numbers, a fact often overlooked in a study of the percentages. Very occasionally the small lymphocytes are reported absent. Early in the case the erythrocytes are but slightly diminished; later they may be reduced to 1,000,000 per c.mm. Nucleated red cells are very common, even with an erythrocyte count of 4,000,000 or more per c.mm. As a rule, the hemoglobin is reduced, percentages of 50 or less being quite common. (See colored plate opposite page 380, Vol. V.)

The writers found that a protease is present in the lymphocytes of chronic lymphoid leukemia and in the leucocytes of acute and chronic myeloid leukemia and of pus. Lipase occurs in the white cells in the same conditions. Amylase is contained in the granular leucocytes of pus and of myeloid leukemia, acute and chronic, and in the lymphocytes of chronic lymphoid leukemia. Maltase

is likewise a product or constituent of these cells. Morris and Boggs (*Archives of Intern. Med.*, Dec., 1911).

The writers cultivated leucocytes from leukemic blood, according to

New method of detecting abnormal leucocytic pictures. After an application of either the galvanic, sinusoidal, or faradic current for about fifteen minutes, a marked descent of the leucocyte count occurs in cases



Case of chronic lymphatic leukemia, showing outline of liver and spleen below costal margin. (*H. K. Thoms.*) (*Yale Medical Journal.*)

Carrel's method. They found that young leucocytes were capable of energetic multiplication, and by further development might be transformed into giant cells and microphages. Avroroff and Timofeerosky (*Roussky Vrach*, May 11, 1913).

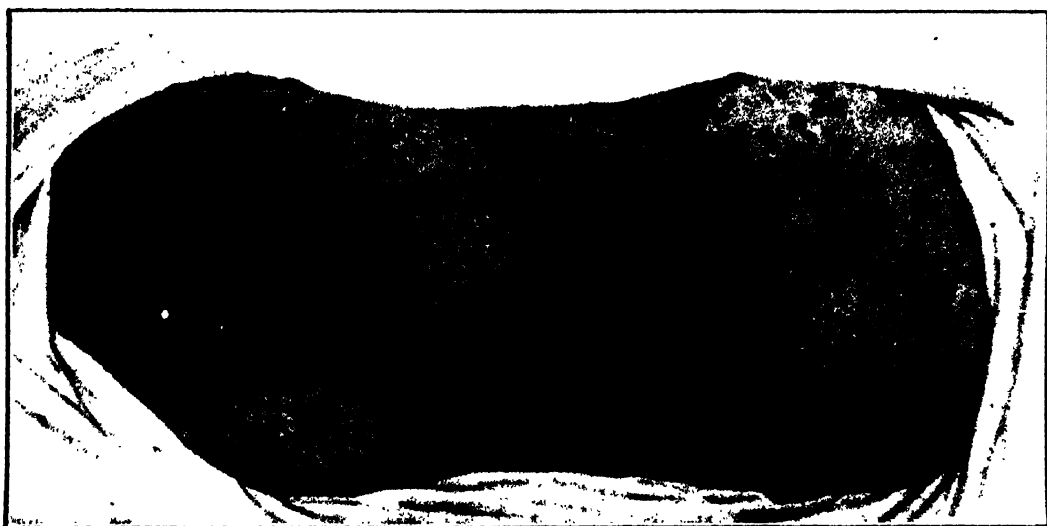
of myelogenic leukemia. Veraguth and Suyderhelm (*Münch. med. Woch.*, Feb. 10, 1914).

Chronic Lymphoid Type.—This is less common than the myeloid leukemia. The onset is insidious, the

first complaints being malaise, weakness, loss of appetite, and pallor. The lymphatic glands enlarge early in the course of the disease, and in some cases this is the first evidence of abnormality. The enlargements may be noticeable for years before symptoms attract the attention of the patient. All the lymphatic glands of the body enlarge. Externally, the cervical, axillary, and inguinal glands become the largest, while internally the

pains in her bones from time to time, particularly the breast bone, and also in the small of her back and ribs. Otherwise she had not had any illness which appeared to bear on her present condition.

The nodules first appeared on the lower part of the abdomen, and rapidly spread over the front of the body. Each individual nodule was at first small, about the size of a pea, and grew in the course of a few days to the size of a large raisin. When the nodules first ap-



Leukemic nodular infiltration of the skin. (Rolleston and Fox.)
(British Journal of Dermatology.)

mediastinal and abdominal glands attain great size. Usually there is little or no pain in the glands.

Dyspnea, cough, and edema of the arms or legs are often very troublesome and are due to pressure. Itching of the skin may cause great distress, frequently being associated with urticaria. Lymphomata may occur in the skin over any part of the body.

Case of atypical myeloid leukemia with nodular infiltration of the skin. The patient, a widow aged 58 years, complained of "lumps in the skin," which she had first noticed two months previously. For several months before this she had noticed

peared they were much darker than at present, in fact almost black; they did not cause any itching or pain. She was fairly well in herself, only rather weak. She had lost about 16 pounds in weight in the last two months. H. D. Rolleston and W. Fox (Brit. Jour. of Dermat., Dec., 1909).

The cutaneous lesions of the leukemias include chloroma, multiple myeloma, lymphoderma pernicioso, and mycosis fungoides. In relation to the last Pardee and Zeit have recently reported a case of mycosis fungoides which later turned to a lymphatic leukemia. The lesions consist of pigmentation, edema, vesicles, papules, nodules; tumors, espe-

cially of the face; urticaria, diffuse erythroderma, macules, and pruritus. Hazen (Wash. Med. Annals, July, 1911).

The term nodular leukemia applies to all those cases in which nodules or tumors of leukemic growth have been found. Such cases have been reported under a great variety of titles, *e.g.*, mycosis fungoides, chloroma, Mikulicz's disease, Kaposi's disease, sarcomatosis, etc. The one great point to be observed is the avoidance of operations which later prove to have been unjustifiable.

The chief significance of the nodules lies in the necessity of differentiating them from true sarcoma and other conditions producing similar symptoms. Ward (Proceed. Royal Soc. of Med., May, 1912).

Leukemia, lymphosarcoma, etc., in children are preagonal states; the organism, exhausted by its cytotoxic struggle, has yielded to the action of the pathogenic causes. By watching changes in the blood, this cytotoxic struggle may be seen and when collapse is impending, prompt measures may be able to ward it off, combating the underlying syphilis, tuberculosis, malaria or sepsis. In 45 cases of leukemia he found tuberculosis in 13 cases; syphilis in 7, malaria in 5, streptococcus or staphylococcus sepsis in 4 each, and various bacterial associations in 10. By vigorously combating the primary disease, the tendency to the preleukemia may be arrested. Martelli (Pediatrics, July, 1919).

Fever is present in most cases and nausea and vomiting are common. Anemia occurs earlier than in the myeloid type and when severe causes edema, breathlessness, tinnitus aurium, vertigo, and headache. Hemorrhages are more common than in myeloid leukemia.

The lymphatic glands are movable, hard, discrete, as a rule not tender, and rarely attain the size seen in

Hodgkin's disease. The liver and spleen are enlarged in all cases, but to a lesser extent than in the myeloid form.

Examination reveals a large amount of uric acid; albumin and hyaline casts are commonly found.

The number of leucocytes per c.mm. varies between 10,000 and 1,000,000, the average number being about 100,000. It is often impossible to make a diagnosis from a leucocyte count alone. A differential count, however, always establishes the diagnosis. The lymphocytes vary from 80 per cent. to 100 per cent., both the large and the small varieties partaking in the increase. The polymorphonuclear cells are reduced in number and eosinophiles and mast cells are often absent. Myelocytes may or may not be present. Even early in the course of the disease but 2,000,000 or 3,000,000 erythrocytes per c.mm. may be found, and as the disease progresses their number is still further reduced. The hemoglobin percentage is low. Normoblasts and megaloblasts are usually present and poikilocytosis is common. The erythrocytes stain poorly.

Acute Leukemia.—This is much rarer than the chronic form and is most often encountered in children. Females seem to be more frequently attacked than males. Because of its resemblance to an acute infection, it is probable that in some cases a correct diagnosis is not made. Indeed, the diagnosis depends almost solely on the blood examination.

Pain in various parts of the body and weakness are the first symptoms. Weakness increases rapidly and in a short time the patient is prostrated. Hemorrhage is extremely common and occurs from the nose, gums, ton-

sils, gastrointestinal mucous membranes, and into the skin. Cerebral and retinal hemorrhages may occur. In some cases severe bleeding has been the first symptom. Frequently ulceration occurs at the site of hemorrhage, especially in the mouth, where it simulates noma.

Case in which the signs and symptoms of lymphoid leukemia in a child vanished at the onset of noma. They returned later, however, after the recovery from the acute infection, and the child died. Samson (*Berl. klin. Woch.*, Feb. 3, 1908).

Three patients with acute lymphatic leukemia, all dying within thirty days from the time the disease was diagnosed. They were aged, respectively, 10, 16, and 11 years. The symptoms and blood-findings were in all 3 in a general way similar. Bodenslab (*Jour. Amer. Med. Assoc.*, Mar. 30, 1912).

Acute myeloid leukemia is frequently accompanied by cutaneous, mucous, or visceral hemorrhages. In certain cases these hemorrhages are so abundant or numerous that an actual hemorrhagic form of myeloid leukemia can be spoken of; the author reports 6 cases of this kind. Ter-Barseguian (*Revue méd. de la Suisse Romande*, Aug., 1913).

Fever is usually present and may be high (103° to 104° F.— 39.5° to 40° C.). The temperature curve is very irregular and may suggest sepsis. Occasionally it resembles the curve of typhoid fever.

Just before death the temperature may become subnormal. The skin takes on a wax-like yellowish or grayish pallor and puffiness of the face and edema of the ankles are commonly observed. Toward the end dyspnea may occur, the pulse increases in rate and becomes feeble. The liver, spleen, and lymph-glands enlarge rapidly. The cervical and submaxillary nodes

are often the first to show enlargement. Sometimes the course of the disease is so rapid that death ensues before the glands enlarge. Albumin may appear in the urine; casts are usually absent. Hematuria may occur. The excretion of a large amount of uric acid is very common.

Pathognomonic evidence of the nature of the disease is to be found in the blood, examination of which reveals a great increase in the number of leucocytes. Usually the proportion of white cells to erythrocytes is 1:20 or 1:10. Cases are reported with ratios of 1:3 and 1:2. The actual number of leucocytes per c.mm. of blood ranges between 200,000 and 500,000. In the majority of cases there is a great increase in the number of lymphocytes (80 to 100 per cent.), the large cells predominating. The polymorphonuclear cells constitute but a small percentage. Eosinophiles and myelocytes are usually less than 1 per cent. Rarely the myelocytes predominate. The erythrocytes number about 3,000,000 per c.mm., though occasionally they may fall as low as 1,000,000. A few nucleated red cells are usually observed. The hemoglobin is reduced to less than 50 per cent. in most of the cases.

The acute differs from the chronic myeloid leukemia in the absence of the increase of the eosinophiles and the fatty granular cells, and gives as characteristic symptoms of the acute form the usually very great anemia, the relatively slight swelling of the spleen and of the lymphatic glands, and ulcers of the mucous membrane of the mouth. Hirschfeld (*Berl. klin. Woch.*, June 27, 1907).

In the acute types of the disease the process goes on so rapidly that still younger types of both cells, the lymphoblast and the myeloblast, in-

vade the blood. Both forms of cells are free from granules and look so much alike that it is impossible to tell whether they are of lymphatic or medullary origin. A valuable reaction solves this difficulty. It depends upon the fact that all medullary cells possess ferments in their protoplasm, while lymphatic cells are free from such ferment. The blood-smear is fixed in formalin, then dipped for a short time in a 1 per cent. aqueous solution of alphanaphthol and for a short time in a 1 per cent. aqueous solution of dimethyl-paraphenylenediamine (Merck). A deep-blue color will form in the presence of ferments; hence only cells derived from the bone-marrow will exhibit blue granules. Schultze (Munch. med. Woch., Jan. 26, 1909).

The occurrence of a positive *indophenoloxidase reaction* in large non-granular cells in acute leukemia is certain proof of their myeloid nature, and allows a diagnosis of acute myeloid leukemia to be readily made from blood examination. The oxidase reaction is negative in the more embryonic forms of marrow-cells. It is always negative in small myeloblasts, and is probably always negative in the most typical stage of large myeloblasts with uniformly dense basophile reticular protoplasm. When it falls positive in these large non-granular cells it is associated with alterations in the protoplasm which are recognizable by ordinary staining methods, and which indicate stages of ripening toward the granular myelocytes. Cases of acute myeloid leukemia may occur in which the type of blood formation is so embryonic that the oxidase reaction is valueless for differential diagnosis, but even in such cases the histological characters of the large leucocytes may render a diagnosis possible. J. S. Dunn (Quarterly Jour. of Med., Apr., 1913).

Literature shows 28 proven cases of myelogenous leukemia, 27 probable cases and 18 doubtful ones. The onset suggests an acute infection, the

weight of opinion favoring also such a cause, although different toxins produce the same picture. The indophenolblue synthesis test as modified by Graham differentiates from the acute lymphatic forms. Gorham (Albany Med. Annals, May, 1917).

The disease runs its course in a few weeks or months, death occurring from progressive inanition. Hemorrhage and rupture of the spleen sometimes cause a fatal termination. An infection may occur as a complication and cause death from sepsis.

DIAGNOSIS.—If the blood is examined the diagnosis of leukemia is made with great ease, whereas without such an examination it is often impossible to make a correct diagnosis. Acute leukemia presents the greatest difficulty in diagnosis. The fever, if accompanied by intestinal hemorrhage, suggests typhoid fever. Cases that present spongy, bleeding gums, with hemorrhage into the skin, suggest purpura hemorrhagica. Many cases strongly resemble sepsis. As previously stated, however, an examination of the blood, including a differential leucocyte count, will clear away the difficulties in diagnosis. It should be borne in mind that occasionally, in chronic lymphoid leukemia, the leucocytes may be no more numerous than is frequently the case in infections; also in the chronic myeloid, as well as in the lymphoid type, the leucocytes may be reduced to normal numbers during an intercurrent infection. Therefore, it is essential to make a differential leucocyte count to avoid mistakes in diagnosis.

ETIOLOGY.—Practically nothing is known concerning the cause of leukemia. Cases have been reported following trauma, but up to the present time no definite evidence has been

produced to show that injury bears a causal relationship to the disease. Malaria and other infections, poor food, insanitary conditions, worry, overwork, and heredity are of little importance etiologically. It has been suggested that the disease, particularly the acute type, is infectious in origin, and various bacteria and bodies thought to be animal parasites have been reported as present in the blood of some cases.

Case of acute myeloid leukemia in a stable boy of 15 who had septic staphylococcal hemorrhagic pericarditis, preceded by acute tonsillitis. Fourteen days after the first symptoms the blood was loaded with myeloid cells, and the clinical diagnosis of acute leukemia was confirmed by the microscopical findings in the spleen and bone-marrow as well as in the blood. Ziegler and Jochmann (Deut. med. Woch., Bd. xxxiii, No. 19, 1907).

The writers have repeated the work of Ellermann and Bang on chicken leukemia, and have brought forward the first proof of the transmissibility of leukemia. Their inoculations were made from a leukemic hen furnished by Ellermann and Bang. The results obtained confirm fully those of the above-named authors. Of 49 hens inoculated, 18 developed leukemia and 4 pseudoleukemia. Subcutaneous inoculations of emulsions of liver, spleen, and bone-marrow always gave negative results; the success followed intravenous injections. Hirschfeld and Jacoby (Zeit. f. klin. Med., Bd. lxxix, S. 107, 1910).

Case of acute leukemia due to *Staphylococcus*. The patient was a woman of 38 who died within a week from the first symptoms. Her brother was brought to the clinic not long after with typical lymphatic leukemia and it was learned that a cousin had died a year before from a similar affection. Barrenscheen (Wiener klin. Woch., Feb. 22, 1912).

Some acute infectious disease is the forerunner of leukemia and allied conditions. Acute leukemia is in itself the clinical picture of an acute infectious disease of intoxication. Many of its manifestations resemble those of severe diphtheria and other septic diseases. Hansemann (Berl. klin. Woch., Jan. 5, 1914).

Case of acute leukemia in a previously healthy and well-to-do man of 50 who developed acute leukemia with hemorrhages from the mouth and death from progressive weakness in six months. The man had been a vegetarian for many years and scorbutus had been the diagnosis at first, until examination of the blood showed micromyeloblast leukemia. Leukemia is unmistakably an infectious disease. Citron (Deut. med. Woch., Mar. 26, 1914).

There is a congenital form of leukemia which occurs in children whose parents are not leukemic; leukemic parents have never been known to transmit the disease to the newborn child; instances in which actual infection of one person by another might seem to have occurred are very few, although not necessarily devoid of significance; in having a marked preference for a particular sex and age leukemia differs from the infectious and resembles metabolic diseases and cancer. Gordon Ward (Brit. Jour. of Children's Dis., Mar., 1917).

Rigid investigation has failed to prove any of these claims. Some authorities consider the chronic lymphatic type of leukemia to be closely related to the neoplasm, i.e., lymphosarcoma.

Myelogenous leukemia is a malignant neoplastic disease. Its onset is insidious, and it is usually fatal. It is sometimes favorably influenced by intercurrent disease, and it is usually influenced favorably by X-rays. In favor of its malignancy is the fact that in many of the organs are masses of cells identical with those of bone-marrow, which are foreign

to the organs involved, and are apparently metastases. Harris (Amer. Jour. Med. Sci., July, 1908).

Acute myeloid leukemia in 2 previously healthy children with apparently mild scarlet fever developed varicella during convalescence and in connection with this a severe hemorrhagic sepsis, fatal in a week. The necropsy findings were those of acute myeloid leukemia. Animals inoculated with cultures from the 2 children confirmed the diagnosis of a streptococcus sepsis. C. Sternberg (Wiener klin. Woch., Nov. 23, 1911).

Case of lymphoblastic leukemia in a child 5½ years old, noteworthy because the lymph-glands of the neck and elbow were converted into a common heterotopic growing tumor which produced macroscopically the picture of Sternberg's leucosarcomatosis. Herxheimer (Münch. med. Woch., Nov. 18, 1913).

Leukemia is a rare disease. The myeloid form is seen more frequently than the lymphoid. Most cases of chronic leukemia occur between the ages of 20 and 50 years. It is almost twice as common in males as in females. On the other hand, acute leukemia is more often observed in females under the age of 20 years.

The average duration of the chronic form is only fifteen months from the time of first observation. Death may occur by the failure of the erythroblastic function of the bone-marrow, and the presence of severe anemia with large numbers of nucleated red cells is of grave prognosis. Exhaustion of the leucoblastic tissues, as shown by the decreased production of the leucocytes and the immaturity of the forms produced, would seem, however, to be the more usual cause of death. Treatment by X-rays and arsenic causes no improvement or a striking one which is only temporary. The fatal issue sometimes is hastened by these measures of treatment. The

absence of marked splenic enlargement in the acute cases is suggestive of a failure of the protective action of the spleen. Panton and Tidy (Lancet, May 18, 1912).

PATHOLOGY.—The essential lesions are found in the spleen, bone-marrow, and lymph-glands.

The *spleen* is always enlarged and, in the chronic myelogenous form, may reach huge proportions. The organ retains its shape, is smooth, hard, and circumscribed areas of perisplenitis are visible. Adhesions may bind the spleen to the surrounding structures. On section the color is mottled gray or grayish red. Hemorrhage into the substance may be found. Microscopically, the structure closely resembles bone-marrow. The Malpighian follicles disappear and are replaced by masses of leucocytes through which capillaries course. The masses of leucocytes are composed of myelocytes, polymorphonuclear neutrophils, and mononuclear cells. Many nucleated erythrocytes are present.

Seven cases of leukemia developing after an accident involving the spleen, including 2 in which it followed splenectomy. Amputation of the thigh was responsible for the leukemia in Murrich's case. In both the writer's cases the spleen was directly injured in a fall or in an accident, bending the body far over backward. The extreme pallor and weakness and the leukemic blood-findings continued a progressive course until each of the young men died of intercurrent pneumonia in about two months after the traumatism. Facchini (Gaz. degli Osped., May 18, 1913).

Changes in the *bone-marrow* are observed chiefly in the shafts of the long bones and in the sternum. The fat is replaced by soft, rather tough tissue, described by Sir William Osler

as resembling the consistent matter which forms the core of an abscess. It is grayish white in color, but takes on a reddish tint on exposure to the air. Microscopically the mass is composed of myelocytes, polymorphonuclear neutrophiles, eosinophiles, mononuclear leucocytes, and erythrocytes.

The *lymph-glands* in the myeloid form are slightly, if at all, enlarged, though in the abdomen they may reach the size of a walnut. In the lymphoid form considerable enlargement of the glands of the entire body may occur. Many of the glands show a normal microscopic picture, while in others changes similar to those in the spleen and bone-marrow occur. The lymphatic tissue in the gastrointestinal tract may be involved and ulceration of Peyer's patches is sometimes found.

The *liver* is enlarged in most cases. It is grayish yellow in color. Microscopically, the capillaries are found overdistended with leucocytes, causing pressure atrophy of the liver cells. Numbers of distended capillaries may coalesce, thus forming leucocytic masses sometimes called leukemic tumors.

The *lungs* show changes like those described in the liver, *i.e.*, overdistention of the capillaries by leucocytes. This encroaches upon the air space and is one of the causes of dyspnea. Compression of the bases of the lower lobes from pressure of the enlarged liver and spleen is commonly found. An effusion of serum is not uncommonly present in one or both pleural cavities. Marked edema of the lungs may be found.

The *heart* chambers are usually distended by clotted blood. Ecchymoses

of the pericardium and endocardium are often found. Microscopically the picture of fatty degeneration is presented.

The *thymus gland* may be slightly enlarged, though, as a rule, no changes are found.

The capillaries of the *kidneys* may be overdistended with leucocytes and, just as in the liver and lungs, they may coalesce to form leukemic tumors. The same coalescence may occur in the capillaries of the skin.

The *tonsils* are often enlarged, especially in the acute cases, and ulceration may be present here and also in the nasal and pharyngeal mucous membrane. The gums are often spongy and ulcerated. No changes are found in the nervous system, except those secondary to hemorrhage into the brain.

PROGNOSIS.—Leukemia is probably always a fatal disease. There is no well-authenticated instance of recovery on record. In acute cases death occurs in a few weeks or months. With the chronic form patients may live for one to five years. Sir William Osler ("Princ. and Prac. of Med.," 8th ed., 1912) states that he saw a patient with chronic lymphatic leukemia ten years after the diagnosis had been made. Remissions in symptoms occur once or more during the course of the disease. Leukemic individuals are especially prone to infections, boils and abscesses being of frequent occurrence. Death from septicemia is not uncommon. Tuberculosis, especially the miliary form, is very common. It has been frequently observed that during the course of an infection, *i.e.*, pneumonia, carbuncle, erysipelas, the leucocytes may be diminished near or to normal num-

bers. The number of leucocytes per c.mm. of blood is not always in direct relationship to the severity of the symptoms, though, as a rule, the greater the number, the more severe the disease. In acute lymphoid leukemia a preponderance of large mononuclear cells usually indicates an earlier fatal termination.

TREATMENT.—There is no curative treatment for leukemia. Among drugs, **arsenic** is given first place. It should be used to the point of tolerance, if used at all.

Better results have lately been obtained by the use of **Röntgen rays** and the internal administration of **benzol**. The former has been tried over a longer period than the latter, and in the hands of experts it is possible in almost every case to reduce the number of leucocytes to normal and at the same time to cause the general symptoms to vanish. The rapidity of reduction in the number of leucocytes depends on the intensity of treatment. The differential leucocyte count approximates normal. Early in the treatment of myeloid leukemia the pathological cells decrease and may even disappear, while in the lymphoid type the qualitative change is observed only after the number of leucocytes has been reduced to or near normal. The erythrocytes and hemoglobin are increased, after a preliminary decrease, in almost all cases of myeloid leukemia, and less frequently in the lymphoid variety. As the number of erythrocytes is increased the nucleated red cells decrease. The spleen slowly decreases in size and may even return to normal. The first evidence of beneficial action of the rays on the spleen is a diminution in the resistance on palpation, and coincidentally

the patient is conscious of a sense of diminished weight in the abdomen. As the shrinking of the spleen progresses pain may occur, due to stretching and pulling on the adhesions which attach the organs to surrounding structures. Enlarged lymphatic glands disappear rather promptly. The excretion of uric acid is increased, fever disappears, strength returns, and the patient is enabled to assume an occupation. The best results are obtained in chronic myeloid leukemia.

In the beginning of treatment, especially if it is intensive, dizziness, vertigo, vomiting, diarrhea, and loss of weight may occur. These symptoms are those of a toxemia, due to a sudden liberation into the circulation of a large quantity of the destructive products of leucocytes, and their appearance demands either a diminution in the intensity or the suspension of treatment for a time.

The good results of Röntgen-ray treatment are brought about by: (a) The primary destruction of lymphoid and myeloid tissue with inhibition of their ability to proliferate; (b) diminution of toxin formation due to inhibition of the formation of pathological cells; (c) the occurrence in the blood of a substance formed from the decomposition products of destroyed leucocytes which influence the blood-making organs.

In the course of treatment of chronic leukemia by the rays, four phases are observable, viz.: (1) The initial disturbance of the general well-being; increase in leucocytes with a secondary, step-like decrease; (2) gradual betterment in the general condition and gradual increase in the erythrocytes and hemoglobin; (3) a period

of latency, during which the patient may feel practically well; (4) a recurrence of symptoms. The duration of the period of latency averages about six months, at the end of which time another course of treatment is necessary, as indicated by a return of abnormal cells to the blood in increasing numbers. The patient may thus be carried through a number of years before the rays become ineffective. Sometimes after a short period of latency an "explosive" recurrence ends in death. The duration of the other phases is also variable.

Successful treatment of a leukemic patient by the **X-ray**. The writer directed his X-ray therapy to the spleen, and incidentally to the end of the long bones, and in this has been followed by most of the workers. Senn (*Med. Rec.*, Aug. 22, 1903).

Account of 2 cases, both of which were given **arsenic**, and 1 of which was treated with the **X-rays**. Both cases, however, showed marked improvement of the blood-picture and the other symptoms; hence, there was doubt as to the part played by the X-ray. Bryant and Crane (*Med. Rec.*, Apr. 9, 1904).

The writer has met with success in the treatment of leukemias during the last three years, that is, since the **X-rays** have been utilized for this purpose. Ten of the 26 patients suffering from **myelogenous** leukemia recovered under treatment with the rays, the spleen diminishing to normal size, and the blood assuming its usual picture. Three of the 10 had relapses, but a second course of treatment again proved efficacious in curing them. Only 1 patient with **lymphatic** leukemia was cured of the disease, if freedom from the signs of the affection for the period of two years constitutes a cure. In general, this type of the disease proved quite refractory to the X-ray therapy. Grawitz (*Berl. klin. Woch.*, June 15, 1908).

Report from Koranyi's clinic of 44 cases of leukemia, lymphosarcoma, or mediastinal tumors treated with the **Röntgen rays** since 1904. It is especially important that this treatment should be applied in the early stages; later, much more intensive treatment becomes necessary, with all its inherent dangers. The writers advise radiotherapy for all tumors in the mediastinum and all phenomena suggesting lymphomatosis and leukemia.

For ten or fourteen days strong daily exposures for eight or ten minutes are advocated. Then the exposures are suspended while the patient's sensitiveness to the rays is determined and the appearance of by-effects awaited. After this period of observation the treatment is continued until signs of improvement or of the inefficacy of the measure become evident. They keep up the exposures for two or three months in case of a mediastinal tumor. Elischer and Engel (*Zeit. f. klin. Med.*, Bd. lxxvii, Nu. 1-3, 1909).

The writer emphasizes the importance of keeping the patient under constant supervision, so as to institute another course at the first signs of exacerbations. By this means it is possible to keep the patient in good condition with fair earning capacity for years. One of his patients was thus able to work at his trade of cabinetmaker for two years after comparative retrogression of the myeloid leukemia, dying then of ulcerative endocarditis. M. Sternberg (*Deut. med. Woch.*, Mar. 23, 1911).

In 6 cases of leukemia of the splenomyelogenous type, 4 followed the usual habit of discontinuing treatment as soon as the beneficial effect of the **Röntgen ray** made them feel perfectly well and enabled them to resume their usual pursuits. The only facts of importance taught by these cases are that under proper dosage almost hopeless cases will respond rapidly to treatment; that this improvement is marked enough to cause the patients to feel that

they are practically cured; that after cessation of treatment the disease recurs; and finally, that these recurrences are also amenable to treatment, though the response is successively less satisfactory. Thomas (Cleveland Med. Jour., Apr., 1912).

The **radium** treatment exerts an immediate very powerful action on myelogenous leukemia when applied over the enlarged spleen for twenty-four hours in relatively large amounts. After three or four applications of from 30 to 33 cg. of radium sulphate, the spleen was found to return to its normal size and the total and differential leucocytic counts to their physiological level, while all the general symptoms disappeared. These effects were noted in 5 cases, all of which had previously been subjected to the Röntgen rays. In 2 patients recurrence took place two and sixteen months, respectively, after cessation of the treatment, and its resumption failed to yield the results previously obtained, possibly owing to insufficient dosage.

This treatment may prove useful in dealing with patients that cannot be removed to the office of the röntgenologist, and is capable of arresting for a considerable time the progress of the disease. In view of the possibility of a difference between the physiological effects of radium and those of the **X-ray**, the authors suggest that these two agents be tried in alternation or in association. Rénon, Degrais, and Dreyfus (Presse méd., June 18, 1913).

In the first stages of **X-ray** treatment the leukemic tissues show great degeneration and destruction of the white-cell-forming tissue. This may completely disappear from the spleen, and the process of white-cell formation may be so inhibited that an aleukemic condition of the blood may result. After some months there arises a more undifferentiated leucoblastic tissue, particularly in the retroperitoneal hemolymph-nodes and in the bone-marrow; the leukemic condition of the blood may or may

not return. With an increasing cachexia the process may be terminated by symptoms of intoxication or by some secondary event, as hemorrhage from the necrotic spleen. A. S. Warthin (Am. Jour. Med. Sci., Jan., 1914).

Where neither **X-rays** nor **benzol** alone is sufficient to control the disease, the two may be effective when given simultaneously. Edmund Myers (N. W. Medicine, Sept., 1916).

X-ray treatment is the most successful and safest agent. The rays should be directed mainly against the bone-marrow. Treatment of the spleen consists in dividing it into zones of 8 to 10 cm. in diameter; crossfiring is then practised from the front, side, and back. Only 1 area is treated at a time. **Arsenic** in small doses is advocated where improvement ceases; also in cases with a low red count or the reds and hemoglobin diminishing. H. K. Pancoast (Amer. Jour. of Röntgenology, Jan., 1917).

Radium treatment by surface application is advocated by the writer in cases of leukemia resistant to the X-ray and benzol. The resulting remission may last months or years. Ordway (Boston Med. and Surg. Jour., Apr. 5, 1917).

Sometimes the general condition improves, but the blood remains definitely abnormal. A few cases are apparently refractory to X-ray treatment.

Results with the use of **Coley's mixed toxins** in 5 cases of leukemia do not yet warrant the statement that the toxins will compare favorably with the excellent results sometimes afforded by X-rays, but so far they have been encouraging enough to justify further trial. Larrabee (Boston Med. and Surg. Jour., Feb. 6, 1908).

Recently **thorium X** has been administered intramuscularly and subcutaneously in salt solution. Its action is very similar to that of the Röntgen rays except that it is a little more rapid. Insufficient time has

elapsed to permit of a satisfactory comparison of the end-results with those of the X-ray.

Case of chronic myeloid leukemia treated with **thorium X**. There was a rapid decrease in the number of leucocytes from 109,000 to 8800 five days after administration of the compound. On the fifty-third day following the injection the white cells numbered 4180. More remarkable than this was the disappearance from the blood of myelocytes, which originally constituted 30 per cent. of the leucocytes. J. Plesch (Berl. klin. Woch., Bd. xlix, S. 930, 1912).

In July, 1912, A. von Koranyi (Berl. klin. Woch., 1912, No. 29) published a case of myeloid leukemia in which very marked improvement occurred following the use of **benzol** (C_6H_6). There were also reported several cases of benzol poisoning, a striking feature of which was a marked leucopenia. Since Koranyi's paper many other contributions have been added, all showing that benzol causes a preliminary rise in the number of leucocytes, followed by a marked diminution during the second or third week of treatment. The erythrocytes at first decrease, but later they increase, as does also the hemoglobin. The spleen decreases in size, in some cases returns to normal, and the general condition of the patient improves. The lymph-glands are less readily affected. When used in conjunction with the **X-rays** the improvement is more rapid than when either is used alone.

From 2 to 5 Gm. (30 to 75 grains) of chemically pure benzol should be given in twenty-four hours, and may be given by mouth or may be injected into the muscles or under the skin. It is best administered in capsules containing 0.5 Gm. ($7\frac{1}{2}$ grains) each

of benzol and olive oil. In the beginning of treatment a capsule should be given four times a day; later 2 capsules three times a day; then 2 capsules four times a day; and finally 2 capsules five times daily. The rate of increase depends upon the tolerance of the patient and the effect upon the blood-picture. It should not be given when the stomach is empty. Sometimes a burning sensation in the stomach, eructation, vertigo, and a transient tracheobronchitis are observed after its administration. When the leucocytes are diminished to 20,000 per c.mm. the use of the drug should be discontinued, as leucocytic reduction continues for some time afterward. Death may result from the too long continued use of benzol. The toxic effects observed by Selling (Bull. Johns Hopkins Hosp., xxi, 1910) were purpura, bleeding from the gums and mucous membranes of nose and pharynx, hemorrhage into the viscera and retina, vertigo, weakness, vomiting, and syncope. The blood-platelets were much diminished, leucocytes almost disappeared from the blood, and the erythrocytes degenerated.

Benzol is a dangerous agent; therefore, its use must be controlled by frequent examination of the blood. In several cases reported the treatment had to be stopped because of the appearance of a red, slightly papular rash, later changing to a reddish-brown color and followed by desquamation. Edema of the eyelids occurred. The urine remained free of albumin.

Case in which X-ray treatment had been without effect, but **benzol** in doses of 60 drops a day caused a slow but continued betterment in the general condition, splenic enlargement,

leucocytosis, myelemia, and anemia. In the second patient, previously untreated, benzol in the same dose brought about in two weeks a considerable improvement in the general state, with suppression of fever, diminished volume of the spleen, and fall in the leukemia from 300,000 to 80,000 cells. Aubertin (*Bull. et Mém. de la Soc. méd. des Hôp. de Paris*, May 23, 1913).

The writer gave **benzol** in doses of 7 minims (0.5 c.c.), increased to 15 minims (1 c.c.), in capsules, after meals and at bedtime, in 5 cases—4 being myelogenous and 1 lymphoid. The results were a rapid fall in leucocytes, resulting in leucopenia in 3 cases; diminution in size of spleen; improved red-cell count and hemoglobin; disappearance of lymphnodes in lymphoid case; improved general condition. The use of drug should be controlled by frequent blood examinations. Billings (*Jour. Amer. Med. Assoc.*, Feb. 15, 1913).

The writer has treated 22 cases of leukemia with **benzol** in the past six months. The benzol was mixed with **olive oil** and given either in milk or in a capsule. The average dose was less than 4 Gm. (1 dram) a day.

The writer's results have not been so uniformly favorable as those reported by Kiralyfi, Koranyi, and others, but he thinks that benzol is a decided aid in the treatment of leukemia. The best results were obtained subsequent to a course of **X-ray** treatment. Klein (*Wiener klin. Woch.*, Bd. xxiv, S. 357, 1913).

The results of **benzol** therapy are variable for two reasons: (1) The cases in themselves vary in intensity and in the fundamental pathological conditions or etiological factors in the bone-marrow, the spleen, or lymphoid system. (2) The results are in some way dependent on the size of the dose of benzol, which dose may be either stimulating or depressing to the tissues involved, and this dose may be peculiar in a marked degree to each case or individual. The effect of benzol should

be carefully checked by daily blood examinations so as to gauge the optimum dose, and to forestall any toxic symptoms. J. Meyers and Jenkins (*Albany Med. Annals*, July, 1913).

In using **benzol** in leukemia the writers warn not to carry its effects too far, destroying the function of the bone marrow. The patient ought to be in a hospital, in bed; the alimentary tract, kidneys, and liver, watched carefully; blood-counts made every few days; the dosage not increased without definite warrant, and the benzol stopped considerably before the white count has returned to normal. Barry and Ketchum (*Ind. State Med. Assoc. Jour.*, Aug., 1916).

In the cases in which benzol is not tolerated by the stomach it may be administered subcutaneously or intramuscularly in 1.5-Gm. (23 grains) doses with equal parts of olive oil twice daily. Severe burning at the site of injection and in some cases gangrene may occur.

It is too early as yet to say that benzol has a curative action in leukemia. One case has been reported in which a fatal recurrence took place during the administration of the remedy. It seems to be ineffectual in the treatment of acute leukemia.

The writers used **benzyl benzoate** in a case of 2 or 3 years' standing. The initial dose was 10 drops of the 20 per cent. alcoholic solution, in water, 3 times a day, after meals, reduced later to 5 drops. When former symptoms recurred the original dose of 10 drops was resumed. Improvement in all the symptoms followed; the patient gained in strength; eats well, sleeps well and is free from discomfort. Haughwout and Asuzano (*N. Y. Med. Jour.*, Aug. 2, 1919).

PSEUDOLEUKEMIA, OR HODGKIN'S DISEASE.

SYNONYMS.—Pseudoleukemia is the term most commonly employed.

In the literature of the disease the following are also encountered: Lymphosarcoma (Virchow); malignant lymphosarcoma (Langhans); malignant lymphoma (Billroth); splenic anemia (Strümpell); anemia pseudo-leukemia infantum (v. Jaksch); chronic relapsing fever (Epstein); multiple myelomata (Rusticky); lymphadenoma (Wunderlich); anemia lymphatica (Wilks); adénie (Trousseau).

DEFINITION.—Hodgkin's disease is characterized by enlargement of the lymph-glands, and sometimes of the spleen, a progressive secondary anemia, fever, and weakness.

[Hodgkin (Medico-Chirurgical Trans., vol. xvii, p. 69) in 1832 was the first to describe the salient features of the disease in reporting a series of cases but 2 of which can now be considered as examples of the disease which bears his name. Markham (Path. Trans., vol. iv, p. 177) in 1853 reported a case before the London Pathological Society. The disease seemed to attract little attention until 1856 when Wilks (Guy's Hosp. Rep., Third Series, vol. ii, p. 114) reported a series of cases, after which reports were published by German and French observers. In 1865 Wilks (Guy's Hosp. Reports, xi, p. 56) again wrote upon the subject and named the disease in honor of Dr. Hodgkin. The disease was described under many names by various authors, due to the fact that its nature was unknown. Even today its etiology and pathology are still under discussion. The work of Reed, Longcope, and others seems to establish a definite pathology for the disease and it is probable that in the near future the cause will be definitely determined to be a corynebacterium. DALAND AND DEVER.]

SYMPTOMS.—In the great majority of cases, and sometimes long before symptoms are recognized by the patient, the lymphatic glands begin to enlarge. Usually the first evidence of

the disease appears in the submaxillary glands or in those in the posterior cervical triangle. In the series of cases reported by Gowers ("System of Medicine," Reynolds, Phila., 1879, vol. v) the order of frequency of affection of the other glands is as follows: (a) Axillary; (b) inguinal; (c) bronchial; (d) mediastinal; (e) retroperitoneal. If the glands in the thorax or abdomen are the first to enlarge, the primary evidence of the disease may be pallor and symptoms due to pressure. These cases present great difficulty in diagnosis.

Ziegler in a series of 120 cases found the primary enlargement in 50 per cent. occurred in the glands in front or behind the sternocleidomastoid muscle on one side of the neck; very rarely on both sides simultaneously. In 10 per cent. the axillary glands of one side were the first affected, and in 6 per cent. the supraclavicular glands. The mediastinal, inguinal, and posterior cervical glands were each the primary site of the enlargement in 3 per cent. of the cases. In 9 per cent. the spleen was observed to be enlarged before there was any glandular change appreciable. In 12 per cent. of the cases no peripheral glandular swellings appeared. Very rarely the retroperitoneal, salivary, or lachrymal glands were primarily involved. Ziegler states that this latent stage varies all the way from a few weeks to fifteen years. Stengel (Prog. Med., June, 1912).

The glands are usually discrete, firm, smooth, and freely movable. Aggregations of nodes may be bound together by loose connective tissue to form huge masses. The glands on one side of the neck may be enlarged for some time before those on the opposite side show involvement. Not uncommonly the disease is seen to advance from the cervical to the su-

praclavicular and axillary nodes on the same side before those on the opposite side are involved. When the submaxillary glands are the first to show disease, extension to the opposite side is more rapid. The enlarged glands may encircle the neck and interfere very materially with the movements of the head. The swellings often invade the mastoid and occipital regions. Sometimes after a group has enlarged, diminution in size occurs and the disease apparently becomes quiescent. It then may burst forth suddenly and terminate rapidly in death. Pain does not accompany the enlargement of the glands and when present is due to secondary inflammatory changes or to pressure upon nerves. Secondary pressure effects are very common. Mastication may be interfered with by the huge mass of cervical glands. Pressure upon the esophagus may cause dysphagia, and in rare instances complete occlusion may occur.

Anemia of the brain may be caused by pressure upon the carotid arteries, in which event tinnitus aurium, dimness of vision, and vertigo upon slight exertion may be observed. If the growth exerts sufficient pressure to further diminish the amount of blood distributed to the brain, irregular breathing occurs, and convulsions, coma, and even death follow. Deafness is a common symptom due to pressure upon the Eustachian tube. Very pronounced cardiac irregularity may be the result of pressure upon the vagus.

A laryngoscopic examination may reveal paralysis of a vocal cord as a result of interference by the enlarged glands with the recurrent laryngeal nerve. In some cases it may be im-

possible to make a satisfactory laryngeal examination because of the displacement of the larynx by the masses. Pressure upon the trachea or bronchi causes cough and dyspnea. Some cases show edema and cyanosis of the head, face, and arms due to compression of the superior vena cava. A unilateral or bilateral pleural effusion may be present, due to direct irritation of the pleura from enlarged glands or from compression of the azygos or bronchial veins.

Severe pain with edema and cyanosis of the arms may result from pressure exerted by greatly enlarged axillary nodes. A similar disturbance may result in the legs as a result of pressure exerted by the inguinal, pelvic, or retroperitoneal glands. Sciatica is sometimes thus produced. If the common bile-duct is obstructed, jaundice will be noted. Secondary growths may occur in the lungs, causing cough and expectoration. Nausea, vomiting, and diarrhea may be caused by involvement of the lymphoid tissue of the gastrointestinal tract. Ulceration in the stomach or intestines may cause hematemesis or melena. Constipation may be due to pressure upon the sigmoid or rectum; complete obstruction anywhere along the intestinal tract is very rare.

Secondary growths of lymphatic tissue may occur in the liver and kidneys, but rarely cause symptoms. The spleen, though it never reaches the enormous size found in leukemia, is enlarged in many cases. The enlargement is not associated with pain. Pruritus may be a very annoying symptom. Bronzing of the skin, suggesting Addison's disease, occurs in some cases and is ascribed to pressure of enlarged glands upon the

celiac plexus. This discoloration of the skin occurs even without involvement of the adrenals. It is sometimes observed after the prolonged administration of arsenic. Masses of lymphoid tissue may enlarge in unusual places in the skin.

The writer agrees with Ziegler and Westphal that from 15 to 25 per cent. of cases show skin lesions. Pruritus is commonest, and next, an exanthem of pruriginous type, most often present on the extensor surfaces. Urticaria is also fairly common and edematous swellings are seen. Pigmentations are frequent.

Alopecia, dryness of the skin, atrophy, and hyperkeratosis are not uncommon.

Icterus and purpuric lesions are less frequent. Reddish or bluish tumors in the skin constitute the condition called "lympho-granulomatosis cutis." H. N. Cole (Jour. Amer. Med. Assoc., Aug., 1917):

Fever is present in the majority of cases. It may be irregular in type and is sometimes absent for considerable periods. On the other hand, there may be a continuous mild fever (100° to 102° F.— 37.8° to 38.9° C.) throughout the course of the disease. The morning temperature may be normal or subnormal and the evening temperature 102° to 103° F. (38.9° to 39.4° C.). Pel and Ebstein have described cases in which relapsing fever occurred, the febrile period lasting about a week, followed by a period of apyrexia of ten days to two weeks' duration.

Blood examinations reveal a progressively increasing secondary anemia. The erythrocytes are reduced to 2,000,000 or less per c.mm. and the hemoglobin below 40 per cent. in late cases. The anemia may become extreme. Often there is no increase in the number of leucocytes, though they

may number 25,000. The polymorphonuclear leucocytes usually number 70 per cent., and a higher percentage is found in cases in which secondary infection has taken place in the glands. Sometimes an increase in the lymphocytes is found. In a few cases the eosinophiles are increased.

The urine is usually negative. When fever is present, especially when above 103° F. (39.4° C.), albuminuria is common.

DIAGNOSIS.—This is often difficult to establish without a histological study of an excised gland. Hodgkin's disease may resemble glandular tuberculosis so closely that a differential diagnosis cannot be made clinically. A tuberculin test often assists very much in making the diagnosis; but it is to be remembered that the reaction may not appear in the cachexia of advanced tuberculosis. It must also be remembered that Hodgkin's disease and tuberculosis are very frequently associated.

Lymphoid leukemia may be confounded with Hodgkin's disease. A careful blood examination, including a differential leucocyte count, will make the diagnosis clear.

It is impossible, occasionally, to differentiate clinically Hodgkin's disease from lymphosarcoma. The histological pictures of the glands are distinctly different in the two conditions. In Hodgkin's disease the gland contains an increased amount of connective tissue, and three types of cells, viz: lymphoid cells, giant cells with one or more nucleolated nuclei, and in most cases eosinophile cells. In lymphosarcoma the mass is composed of a delicate reticulum in the meshes of which lie cells rather larger than lymphoid cells. It penetrates the cap-

sule and invades the adjacent tissues. When the diagnosis is not clear, a superficial lymph-gland should always be removed for histological study. This can be done readily under local anesthesia, without detriment to the patient.

ETIOLOGY.—The cause of Hodgkin's disease is still in doubt. Formerly the disease was thought to be a malignant growth by some observers including Coley.

Hodgkin's disease must be classed with the lymphosarcomas and endotheliomas of the lymph-nodes as a neoplastic process. The following facts compel this conclusion: (a) The similarity, and in cases identity, of the histological process; (b) the early and constant development of malignancy (invasion of capsule and veins); (c) the ultimate formation of true metastases, partly at least by the blood-stream. Oliver (Jour. of Med. Research, Dec., 1913).

Research suggesting that the causal agent is probably a polymorphous fungus which locates in the lymph glands. It can be cultivated from them and is pathogenic for animals. Cultivation on Sabouraud's saccharosed gelose succeeded in about 50 per cent. of the inoculations, the growth with one type of the germ resembling that of cultures from actinomycosis. The other principal type is more bacilliform in aspect and cultures. These differences are more marked at first than later, in time all the cultures resembling each other. The rat, guinea-pig, rabbit and monkeys are susceptible to the germ, and all die sooner or later when inoculated in the peritoneum, although the experimental disease may last for a month or more. The provisional name of the germ is *Adenomyces cruzi*. Dias (Brazil Medico, Sept. 1, 1917).

It is generally believed now that it is an infection, and this belief is supported clinically and histologically.

Sternberg (Zeit. f. Heil., xix, 21, 1898) stated that the disease was a special form of glandular tuberculosis. Since then investigators have brought forth evidence that disputes his view.

[Dorothy Reed (Johns Hopkins Hosp. Reports, x, 133, 1902) and Longcope (Bull. Ayer Clin. Lab. of Penna. Hosp., No. 1, 1903) have shown definitely that Hodgkin's disease and tuberculosis are separate affections. Both processes may, however, occur simultaneously.

Fraenkel and Much (Zeit. f. Hyg. u. infect. Krankheit., lxxvii, 159, 1910) found an organism greatly resembling the tubercle bacillus in 12 out of 13 cases of Hodgkin's disease which were clinically and anatomically free from tuberculosis. The organisms appeared as granular rods, which resisted antiformin, stained by Gram's method, but were not acid-fast. Notwithstanding the absence of clinical and pathological evidence of tuberculosis in the cases, they concluded that, if the organisms found were not actually tubercle bacilli, they were at least closely related to them.

Negri and Miermet (Centralbl. f. Bakt., etc., lxxviii, 292, 1913) confirmed the findings of Fraenkel and Much, but stated that the organism was not related to the tubercle bacillus, but was a diphtheroid organism which belonged to the species *Corynebacterium* and suggested the name *Corynebacterium granulomatis maligni*.

In August, 1913, Bunting and Yates (Arch. Int. Med., vol. xii, 236, 1913) confirmed the findings of Negri and Miermet and agreed with them in the classification of the organism. They suggested the name *Corynebacterium Hodgkini*. The organism is described by them as a non-acid-fast, Gram-staining bacillus, which grows luxuriantly at body temperature and which is a facultative anaërobe. It may occur as plump, short rods, which may closely resemble cocci-bacilli; small, thin bacilli with polar-staining, comma-shaped bacilli; granular rods of variable size; branching forms; club-shaped involution forms, and large, spherical forms. The same investigators (Jour. Amer. Med. Assoc., lxi, 1803, 1913, and Jour. Amer. Med. Assoc., lvii, 516, 1914), by inoculating

monkeys with the organisms, were able to produce in the lymph-nodes a chronic lymphadenitis with a typical proliferation of the endothelial cells and stroma, and a well-marked eosinophilic infiltration. The corynebacterium was also isolated from the lymph-nodes in 12 cases of Hodgkin's disease by Billings and Rosenau (Jour. Amer. Med. Assoc., lxi, 2122, 1913), and Kusunoki (Virchow's Archiv, ccxv, 184, 1914) found them in 16 cases. It is, therefore, probable that the organism found is specific for Hodgkin's disease. When this is definitely determined, a great stride forward will have been made and the possibility of successful treatment will appear nearer of accomplishment. DALAND AND DEVER.]

A certain number of the cases are definitely due to tubercle bacilli. In a fair number of other cases Much's granules have been discovered, which may be considered as evidence of the presence of tubercle bacilli of some variety, probably of reduced virulence. Even where tubercle bacilli and Much's granules have not been found there may yet be some cases caused by the virus of tuberculosis. Definite evidence is now at hand that in cases where Much's granules have been found and injection made the animals so subjected have succumbed to a low-grade tuberculosis. Fraenkel (Verhandl. d. Deut. pathol. Gesellsch., 1912).

The writer isolated a diphtheroid organism identical with that first discovered by Negri and Miermet, in 1 case each of lymphatic leukemia and Hodgkin's disease. Inasmuch as this observation has been confirmed by Bunting and Yates in 7 cases of Hodgkin's disease and by Billings and Rosenau in 12 cases of the same disease, the probability that this organism has some definite relation to Hodgkin's disease is rather strong. A. E. Steele (Boston Med. and Surg. Jour., Jan. 22, 1914).

The disease occurs most commonly in males and usually before the fortieth year. In Longcope's (*ibid.*) series of cases the youngest patient

was 7 and the oldest 35 years of age. It may be that the disease enters through the tonsils, gums, or mucous membranes of the nose or throat. The disease first shows itself in the majority of cases in the cervical glands. There is no evidence that heredity, bad food, exposure to cold or wet, impure air, etc., play any rôle in the production of the disease.

The duration of Hodgkin's disease varies from a few months to several years. An exact study of the duration is not possible because of the difficulty of determining the exact time of onset. The disease may exist for many years without more than slight enlargement of a single group of glands. Then suddenly, general glandular enlargement, with pronounced constitutional symptoms, may occur, followed by death in a few months. In reckoning the duration of the disease, therefore, it may happen that the acute exacerbation only is considered.

Generally the disease is chronic, though acute cases causing death in a few months do occur.

[Gowers (Reynolds's "System of Medicine," Phila., 1879) in a study of 50 cases found that in 18 cases the duration was less than one year; in 15 cases between one and two years; in 6 cases between two and three years; in 6 cases between three and four years; in 3 cases between four and five, and over five years in but 1 case. It seems from this study that most cases die before the third year. The average duration of the whole 50 cases was nineteen months. DALAND AND DEVER.]

The most common cause of death is asthenia. The patient becomes more and more anemic, edema and finally anasarca occur, dyspnea increases, weakness becomes more pronounced, and finally death ends the scene.

Sometimes death occurs suddenly. In some cases starvation due to compression of the esophagus hastens the fatal termination. Death may occur from suffocation due to compression of the trachea.

Intercurrent infections commonly occur and shorten the life of the patient. Pneumonia is common; infection with the tubercle bacillus is very common. Often a group of enlarged glands may be thus infected and, caseating, may discharge pus. Miliary tuberculosis may occur.

PATHOLOGY. — *Lymph-glands.* — Enlargement of one or more groups always occurs, forming lobulated masses composed of discrete nodes bound together by connective tissue. They almost never fuse. The nodes may be soft or very firm, and glands of different consistency may be present in the same group. Sometimes they give a sense of fluctuation, but on incision no fluid is found. The masses are not bound to the skin or adjacent structures and are movable under the skin, unless by their size they have stretched the skin too tightly over them to permit of motion. Necrosis occurs only when secondary infection occurs. On section the appearance varies with the age of the growth. The older growths present a semi-translucent, grayish surface, divided by intersecting lines of yellowish fibrous tissue. The younger growths present a uniform, grayish, bulging surface, somewhat more opaque than normal.

Microscopically, the appearance varies with the age of the growth. In the youngest glands dilatation of the blood-vessels and lymph sinuses is well marked, with proliferation of the flat endothelial cells of the reticulum

of the latter. Later, the lymph sinuses become filled with lymphocytes, usually of the small type, and proliferating endothelial cells, destroying the normal appearance of the gland.

Large epithelioid cells with vesicular nuclei are formed from the proliferating endothelial cells. Many giant cells with one or more nuclei are found. Eosinophiles are usually present in large numbers. As the masses become older the fibrous tissue proliferates, dividing the gland into sections and destroying many of the pre-existing cells. In old masses the connective tissue may be observed in greater amount than the cellular tissue. Rarely the cells of the gland penetrate the capsule. When they do so, they do not invade the surrounding tissue in all directions, but push the tissue cells in front of them, forming a dense border simulating a capsule.

The connective tissue which is so characteristic of the older growths is the result of proliferation of the connective tissue about the blood-vessels. It also develops from the endothelial cells which line the tissue spaces. These cells, in proliferating, form giant cells with one or more nuclei. There may be as many as 10 nuclei in a single cell. Some of the nuclei contain nucleoli. These giant cells are peculiar to Hodgkin's disease.

Metastatic nodules may occur anywhere in the body. They have the same appearance as the tissue of the enlarged glands. As they enlarge, the cells of the organ or tissue in which they grow are pushed aside and flattened out, forming an apparent capsule.

Spleen.—Slight enlargement is often found. Rarely does the organ attain great size. It is firm, preserves the normal contour, and is smooth except

when protrusion of metastatic growths causes the surface to be nodular. On section it is red, purple, and grayish white.

The *liver* may be slightly enlarged, though very frequently no abnormality may be detected. Secondary growths may be present.

The other organs of the body, as a rule, present no changes, except that they may be the seat of metastatic growths.

PROGNOSIS.—As far as known, Hodgkin's disease is always fatal. Patients rarely live more than three years after symptoms become pronounced. As stated, the glands may enlarge and remain so for several years before the patient is conscious of abnormal subjective sensations. Sometimes after a group of glands have been enlarged, diminution in their size may occur, followed by a longer or shorter period of latency.

Death occurs usually from cachexia or is the result of secondary infection. Lobar and lobular pneumonia are frequent complications that hasten death. Tuberculosis is a very common complication. It may occur in a group of affected glands and later become disseminated throughout the entire body. Anemia rarely causes death. Suffocation from pressure on the trachea may be the cause of death. Death from inanition is apt to occur in those cases in which the glands in the neck interfere very materially with mastication, and in those cases in which the ability to swallow food is greatly diminished.

TREATMENT.—Up to the present time no treatment has been effective in saving the life of the patient. Surgical treatment should not be considered except when it is neces-

sary to relieve pressure symptoms that threaten life.

Early diagnosis of Hodgkin's disease is urged. Portals of entry of infection should be sought and eliminated, as by tonsillectomy, healing of chronic cutaneous or mucous membrane lesions, care of the teeth and accessory sinuses, and cure of enterocolitis or constipation. **Early extirpation** of all accessible **enlarged glands** should also be practised, followed at once by prolonged **Röntgen-ray treatment** of the operative field and of all glands not removed. All efforts should be made to improve general health. **Immune serum** should be given for its general and specific effects. Medication may be helpful as a general measure. Excision for diagnosis should never be tried unless one is prepared to make it complete if a frozen section proves positive, as this procedure accelerates the disease. Upon the treatment mentioned, recovery for over 5 years is estimated to occur in less than 5 per cent. of acute cases; 80 to 90 per cent. of incipient chronic cases; 60 to 70 per cent. of early chronic, and 5 to 10 per cent. of advanced and rebellious chronic cases. Yates and Bunting (Jour. Amer. Med. Assoc., Mar. 10, 1917).

Arsenic has been the favored drug, Fowler's solution being given in ascending doses. It is of little service and may be harmful in those cases in which gastrointestinal disturbances follow its use. **Sodium cacodylate** may be used in 1- to 5-grain (0.06 to 0.3 Gm.) doses, hypodermically, on alternate days.

Since 1902 the **Röntgen rays** have been employed, without, however, effecting a cure. Life has been prolonged four or five years from the onset of treatment. Under this treatment the enlarged glands gradually diminish in size and the general state of health improves. If the spleen is

enlarged, it likewise decreases in size. The lymph-glands rarely, if ever, entirely disappear; usually they are felt as masses about the size of a pea.

About 30 cases diagnosed as Hodgkin's disease have been subjected to the therapeutic effect of the **Röntgen rays**. The best results were in single groups of glands, varying in inverse ratio to the number of areas affected. Harris (*Austral. Med. Gaz.*, June 8, 1912).

In a report of 19 cases treated at the Huntington Memorial Hospital the writers found that treatment by **radium** and the **X-ray** is followed by a marked temporary amelioration of the symptoms, a diminution in the size of the glands, and an improvement in the general condition, but that in the majority of cases it does not prevent a fatal ending. Radium seems to be of more value than the X-ray. The improvement is such that patients are comfortable until nearly the end of the disease. The treatment should not be limited to the palpable glands, but be directed against the lymphatic areas of the body, mediastinum, abdomen, etc., from the first. C. C. Simmons (*Boston Med. and Surg. Jour.*, Dec. 13, 1917).

Without treatment all authentic cases of Hodgkin's disease have ended in death. The most satisfactory results are obtained from **X-ray** treatment given in **conjunction** with the **operative methods** and when the tissue examination shows lymphosarcoma instead of Hodgkin's disease, and particularly when polymorphonuclear leucocytosis is not present. Chronic cases do better than acute cases. Intensive prolonged exposures, though effective in chronic cases, are unsuitable in acute cases. Burman (*Surg. Gynec. and Obstet.*, xxviii, 440, 1919).

The glands often enlarge rapidly when treatment is suspended.

In some instances after treatment is discontinued, the glands continue to decrease for a short time. A re-

currence is sure to take place and finally the disease causes the death of the patient.

The **X-ray** treatment should be started with maximal doses of rays from a Coolidge tube, and continued with smaller doses at short intervals. No arsenic should be given during X-ray treatment. Intestinal stasis should be overcome by **bland enemas** twice weekly, and **sulphur** orally, continued until hydrogen sulphide no longer occurs in the stools. A. F. Holding and S. Brown (*Jour. Amer. Med. Assoc.*, Mar. 3, 1917).

Benzol has recently been tried with apparent success, but the cases have been too few to warrant an expression as to its actual curative value in Hodgkin's disease.

Benzol (benzene) used in 6 cases of myeloid leukemia and 1 of Hodgkin's disease with good results. Given in capsules, each containing 0.5 c.c. (8 minims), with same amount of olive oil; at first, 4 capsules daily, after meals; then 2 capsules three times daily; later four times, and finally five times. The leucocyte count was gradually lowered to normal, fever disappeared, and the general condition improved. It proved effectual where other measures, including X-rays, had failed. Kiralyfi (*Wiener klin. Woch.*, Aug. 29, 1912).

Benzol, 5 minims (0.3 c.c.), three times daily at first, then increased to 10 minims (0.6 c.c.), caused marked regression of enlarged nodes, beginning two weeks after treatment was begun, in a case previously treated unsuccessfully with X-rays. The 10-minim (0.6 c.c.) dose was continued 6 weeks. Lawson and Thomas (*Jour. Amer. Med. Assoc.*, Dec. 13, 1913).

JUDSON DALAND

AND

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LEUCOPLAKIA. See TONGUE, DISEASES OF.

LICHEN PLANUS.—DEFINITION.—Lichen planus is an inflammatory disease of the skin in which small, flat, angular, red or bluish-red, shining papules form. These occasionally coalesce and form patches. A variable amount of itching is present. Lichen acuminatus, though formerly considered a variety of the same disease as lichen planus, is now generally conceded to be identical with the pityriasis rubra pilaris of Devergie.

SYMPTOMS.—This eruption begins as small, reddish papules, which become angular, polygonal, or faceted. These papules are red and shining and sometimes show a depression or umbilication due to a glandular orifice present in the center of the papule. The color of the papules may be pinkish red, violaceous, or purple. On the grayish, translucent surface of the papule one may distinguish grayish striae. Scaling is usually absent. The papules may be discrete, but are more often in patches, sometimes arranging themselves in rings (lichen planus annularis), sometimes in lines, and when a beaded linear formation predominates it is called lichen ruber moniliformis. The favorite sites of the eruption are the flexor surfaces of the wrists and arms, although the abdomen, legs, and the back of the hands may be affected. Large areas of the body may be involved.

The eruption of lichen planus appears gradually. Its duration is variable, and, while relapses occasionally occur, distinct second attacks are not common. A brownish pigmentation, which slowly fades, is left after the eruption disappears.

DIAGNOSIS.—The peculiar features of the eruption, its distribution, and the absence of previous moisture will differentiate this affection from eczema. The purple or lilac tint of infiltrated plaques on the legs and the outlying discrete papules will distinguish this disease from psoriasis or eczema.

ETIOLOGY.—Nervous exhaustion is the most common cause, but digestive disturbances seem causative in some cases. Lichen planus is rare in children; it is pre-eminently a disease of adult life.

PROGNOSIS.—This is favorable, but the course of the disease often extends over months.

TREATMENT.—Hygiene and diet are important elements in treatment. **Arsenic** is most useful in the subacute and chronic cases. **Mercury** is frequently a valuable remedy. In **Donovan's solution** (liquor arseni et hydrargyri iodidi) the two are combined. **Salicin** in 15- to 20- grain (1 to 1.3 Gm.) doses is recommended by Crocker in subacute and chronic cases; **potassium chlorate**, **dilute nitric acid**, and **quinine** have also been advised in these same cases. **Change of climate** is often curative. Among the local remedies may be mentioned **tar**, **phenol**, **menthol**, **chrysarobin**, **salicylic acid**, and the **mercurials**. Some cases yield best to the **X-rays**.

LICHEN RUBER ACUMINATUS (PITYRIASIS RUBRA PILARIS).

SYMPTOMS.—This is a cutaneous inflammation marked by small, conical, dry papules with horny centers, occupying the mouths of hair-follicles, running a chronic course, and gradually tending to extend. The three characteristic points of this eruption are horny, follicular papules, pityriasic desquamation, and exaggeration of the natural folds of the skin.

The eruption may first appear on the palms, soles, scalp, or face, giving rise to generalized redness with roughness and scaling. On the scalp it simulates dry seborrhea. On the face fine, adherent scales are found in the frontal, orbicular, and nasolabial regions. The papules are pale yellow, pale red, or of duller hue, and are generally pierced by hairs. Surrounding the hair and penetrating the follicular opening is a horny sheath. A horny plug may occupy the center of the papule. Large areas may be involved. The papules may coalesce and form patches. Horny, black plugs are generally present upon the backs of the first digital phalanges and at the nape of the neck. Itching may be present. The course is chronic, subject to exacerbations, and may terminate in pityriasis rubra. Death from the disease sometimes occurs.

ETIOLOGY AND PATHOLOGY.—The cause of the disease is obscure. It is a disease of childhood and early adult life.

Cornification of the epithelial layers around the mouths of the hair-follicles

produces the horny papule. Follicular hyperkeratosis is the essential lesion. Chronic inflammatory changes in the corium are found in prolonged cases.

PROGNOSIS.—A fatal issue is rare. Recurrence may follow apparent cure. The course of the disease is a very slow one, sometimes ending in recovery, but usually persisting for an indefinite time.

TREATMENT.—The treatment of this affection is that used in psoriasis. The remedies advised are **arsenic, mercury, pilocarpine, thyroid extract, and tonics. Alkaline baths, salicylic acid, tar, pyrogallol, chrysarobin,** depending upon the stage of the disease, are used locally. The general health should not be neglected.

LICHEN SCROFULOSUS.

SYMPTOMS.—This is a chronic inflammation of the skin in which occur flat, reddish or yellowish, more or less grouped, scaly papules, about the size of a millet seed. It affects scrofulous persons, especially the young. The papules originate about the hair-follicles, and are scattered over the chest and abdomen. The course is chronic. The affection is rare.

TREATMENT.—The indications are for **good food and personal hygiene. Cod-liver oil,** internally and externally, will generally cure the disease.

LICHEN TROPICUS. (See MILIARIA, this volume.) W.

LIGHT THERAPY, OR HELIOTHERAPY.

—*Light therapy* properly employs all of the effects of radiant energy except the higher frequencies of the Röntgen ray as affecting the tissues of the organism. *Heliotherapy*—radiant energy from the sun—would, under the present understanding of this department of therapeutics, comprise but a relatively small part of the subject, since the employment of high-candlepower lamps provided with reflectors and lamps of lower capacity, both arc and incandescent, is quite as effective in therapeutics as the sunlight, and more

convenient and not so capricious as the emanations from the sun in most climates.

Radiant energy emanating from any luminous source comprises, besides the visible rays, the radiations of higher and lower frequencies—*ultra-violet* and *infra-red*. From the various sources, natural and artificial, the proportions of different frequencies will vary. The emanations from the sun are rich in all the frequencies, as are also the emanations from the arc light. The radiations from carbon-filament incandescent lamps are rich in all of the frequencies except the ultraviolet. The tungsten-filament incandescent lamps are less rich in the lower frequencies and void of the ultraviolet, but decidedly rich in the luminous rays.

Light in transmission from incandescent bulbs, which is of necessity produced within the glass container, loses the higher frequencies, by being filtered out in their passage through the glass wall of the lamp.

Arc lamps are manufactured with rock-crystal lenses or windows, as were the lamps of Niels Finsen, because they permit the passage of the ultraviolet rays. These lamps are employed particularly for administration of the ultraviolet radiations. The effects of these rays are superficial, producing intense hyperemia and tanning of the outer layers of the skin, and do not penetrate the vascular layers unless they are rendered anemic, as first demonstrated by Finsen.

It must be understood that the effects of radiant energy as affecting the tissues of the body are derived from the transformation of this energy or its conversion into heat or other

forms of energy in the tissues. Again, the physiological effects of the forms of radiant energy must be considered complexly as to the effects of the different frequencies upon the tissues or upon germs or other organisms resident in the tissues. From this point of view the therapeutics of radiant energy has developed an exceedingly important field.

PHYSIOLOGICAL ACTION.—

The physiological effects of radiant energy vary with the intensity and volume of the radiations which penetrate the tissues to a considerable depth. Kellogg has stated that radiant light penetrates fully 6 inches within the tissues. The penetrations of the various wave lengths are unequal. The red and infra-red radiations penetrate deeper into the tissues than the luminous rays and higher frequencies, the radiations of longer wave length and lower frequency having the greater power of penetration. It will be understood, therefore, that the deeper effects of radiant energy are derived from the infra-red radiations producing heat in the tissues relative to the volume of the radiations.

The degree of penetration varies considerably, however, with the color of the skin of the individual. In brunettes, and to a greater degree the negro, the radiations are absorbed in the pigmented layers of the skin and the penetration to the deeper tissues is relatively less. For this reason the intense effects due to absorption of the radiations in the skin cause the sweat-glands to become more active and the perspiration more profuse. This remarkable provision of Nature protects the dark-skinned inhabitants of the tropics from the overstimulating

effects of radiant light in the deeper tissues, and coincidentally the evaporation of the increased perspiration by the latent heat of evaporation produces a marked lowering of the peripheral temperature, especially so when in a dry atmosphere the evaporation takes place promptly. This affords great relief from the thermic effects of the sun's rays. A person having dark-colored skin for the same reason receives very little benefit from therapeutic administration of radiant light and heat, the penetration being proportionate to the degree of pigment in the coloring matter of the skin. For this reason tanning of the skin by the sun's rays by the radiations of the electric arc prevents the therapeutic effects reaching the deeper tissues when indicated.

The electric arc and other sources of radiant light, including the sun, which are rich in ultraviolet radiations, produce tanning and are therefore not so practical for therapeutic applications other than in the most superficial disorders. When the prolonged use of radiant energy is indicated the tanning, after the first applications, prevents the full effect of the other radiations to the deeper tissues. The ultraviolet radiations, however, play a most useful rôle in Nature in that they destroy germ life exposed to them in the atmosphere, in water which they freely penetrate, and on surfaces everywhere. It must be borne in mind, however, that they do not penetrate glass, and, therefore, that they do not sterilize the house air, excepting through the open window. Furthermore, these rays act only on the outer layers of the human skin. In the **incandescent light**, these rays being filtered out by the glass wall of

the bulb, the objectionable feature is removed and the light is rendered practical for its general thermic and other valuable therapeutic effects. This has been demonstrated by numerous observers to their satisfaction in the treatment of various infections and other conditions in which radiant energy is indicated.

The **thermic effects** of radiant energy derived from the various sources arise from its transformation into the lower frequency of heat vibrations in the tissues and are effective as far as they penetrate for both local and general effects.

The **local effects** are to induce as far as the light penetrates a degree of hyperemia, which will vary with the volume of radiations, the toleration of the patient to whom the radiations are applied, and the length of the application.

General Effects.—Added to the local effect, the blood, warmed as it passes through the heated field exposed to radiant energy, conveys a glow of warmth throughout the whole body, producing general perspiration and otherwise increasing general metabolism. When such applications are made for a considerable time the secretory and excretory functions of the body are accelerated, particularly so throughout the exposed parts of the body to which the application is made. General metabolism is thus quickened and increased activity of the normal processes of the whole organism is thus engendered. In addition to these thermic effects of radiant energy there are undoubted influences of light tending to a gradual increase in the red cells in anemic patients. As great an increase as 1,000,000 per c.mm. has been noted by

the writer in one month, which could be attributed to no other cause.

The **actinic effects** of the luminous radiations, though to a less degree than of the ultraviolet, have a marked inhibitory effect upon most forms of germ life. Particularly susceptible to these are the pyogenic bacteria and other bacteria which are sensitive to light, for which reason radiant light plays an important therapeutic rôle in the treatment of conditions characterized by their presence as an exciting cause of local inflammation.

THERAPEUTICS.—The therapeutic indications for hyperemia as induced by applications of radiant energy or any other measure which produces intense and penetrating heat effects locally are of great importance as affecting local metabolism. They increase the nutrition of the cells, enhance their functional activity; simultaneously, infected areas have their resistance increased against the bacteria, owing to the large numbers of phagocytes that are attracted to the heated area. Probably no other effects exerted in any manner upon tissues by local application produce so great an influence for the removal of forms of waste matter and germs from involved tissues, except when the tissues are so indurated that the blood flow is checked. For such conditions a *vis a tergo* of greater energy will be required, except when germs are present and induration circumscribes or walls in local infection. Under such conditions evacuation of pus or the employment of other means to destroy germs is indicated.

[Radiant energy from luminous sources renders one of the most valuable services to therapeutics for the induction of the effects described, one which must be

eventually appreciated by the profession at large. It seems unfortunate to the writer, in the light of the present knowledge of the subject by those who have investigated and demonstrated its value, that so few appreciate the wide field of usefulness of this universally present and obtainable agent. The paucity of literature upon the subject is the indication of the lack of appreciation of the therapeutic indications for radiant energy. There is probably not one measure so generally at the command of the profession that will serve so many useful purposes in the treatment of disease as light therapy. W. BENHAM SNOW.]

From the point of view outlined the therapeutic indications for radiant energy include (1) the treatment of defective local and general metabolism; (2) local repair of impaired or injured tissues, and (3) removal from the tissues of some types of infection, particularly the pyogenic bacteria.

While its effects upon **general metabolism** may be derived from the gradual heating of the blood-stream during local application, the liberal administration by light baths or extensively by high-candlepower lamps to the trunk or large portions of the body at each application is remarkably effective. In **anemia** or in those in whom **autointoxication** is manifestly present with **impairment of the excretory and secretory functions** of the body general applications are invaluable, the effect being to stimulate profuse perspiration and to quicken all of the emunctory functions.

Radiant energy is not effective for the relief of densely congested areas, the seat of extreme conditions of local stasis, applications to which afford but temporary relief from pain due to relaxation of local tension or pressure. For this reason light is of comparatively little value, except at the out-

set, for the treatment of swellings associated with pain, or in the treatment of a chronic neuritis. When used persistently in such conditions the only effect derived is a temporary relief from pain. Other measures, as the static current, which dissipates the infiltration, are far more effective in the treatment of non-infected conditions of local stasis as present in synovitis, sprains, and infiltrated viscera.

In **local infection**, when the presence of germs is the exciting cause of inflammation, application of radiant light and heat is especially efficacious. Especially is this the case in that very large number of such conditions wherein the depressing influence of radiant energy upon germ life and the induction of hyperemia in the field of infection, through which a large number of phagocytes attack and destroy the germs present, are brought actively into play. There are few forms of **pyogenic infection** which, before pus appears, cannot be aborted by energetic applications of radiant light and heat. Though this statement may seem sweeping, the writer and others have demonstrated its value and are convinced beyond question of its importance. Local pyogenic infection is the field in which radiant energy excels all other therapeutic means. The indications, therefore, for the employment of light therapy in local infection, as previously stated, are (1) the induction of local hyperemia, and (2) inhibition of germ development in the field of infection, which favors increased local phagocytosis, resulting in the destruction of the exciting cause of inflammation.

It is important that the applications

should be made near enough to the surface that a degree of heat is projected which cannot be tolerated unless the therapeutic lamp is moved about rapidly over the surface of the infected part. Furthermore, applications should be made for a long time—for one-half to one hour. In acute conditions where infection is severe, applications should be repeated every few hours until there is complete subsidence of the inflammation, indicating a destruction of the germs in the local field. In some cases, as in **acute otitis media**, relief of pain will be a fairly good indication of the cessation of active germ proliferation.

The local infections in which radiant energy is indicated are at present not fully determined. It is safe to say, however, from the point of view of the writer, that it is contraindicated in no condition in which infection is present except when a lesion is under treatment with the X-ray, which produces directly opposite effects. Experience has demonstrated its great value in the treatment of those cases in which streptococci, staphylococci, and the other forms of pyogenic bacteria are actively proliferating, when applied before pus forms or after the local evacuation of pus, in which cases it is possible to abort the infection if employed with energy soon after the onset of pain, which will in most cases indicate the beginning and location of infection.

In **acute otitis media** the application should be instituted at the outset and made by rapidly moving the light over the ear and surface surrounding it until there is complete cessation of pain, repeating the application if there is a recurrence of pain. By this method the trouble will be promptly

arrested and cured if pus had not already formed.

In **chronic otitis media** with a purulent discharge it is possible in all cases except when the ossicles are necrosed to cure the condition within a short time by one or two daily applications. No measure in therapeutics will give greater satisfaction than the results obtained from the application of radiant light and heat in otitis media. It may be applied from a fifty candle-power incandescent therapeutic lamp, the exposure being made for from one-half to one hour once or twice daily.

In **early cases of mastoiditis** it will always be safe to employ radiant light pending an operation, when, if pain is relieved and blood examination shows a lowered phagocytosis, an operation will be unnecessary. Though the value of light therapy in otitis media and mastoiditis was demonstrated to an eminent aurist several years since, it has received little or no attention from those who follow that department of medical practice. When recognized and employed by the family physician or the public at large mastoiditis will be practically eliminated; for in the language of an aurist, "if all cases of otitis media are cured there will be no mastoiditis cases for operation."

In the treatment of **carbuncles**, **boils**, and **felons** the same principle of application and method as employed in the treatment of otitis media will succeed in nearly every instance before pus has formed. Likewise the **early cases of appendicitis** may often be arrested, and aborted by this same measure. The writer has observed temperatures present with acute appendicitis to fall from 1° to $2\frac{1}{2}^{\circ}$ F.

in twelve to twenty-four hours under the application of radiant light and heat with arrest of the active process. In **suppurative tonsillitis** when applied in the same manner as in otitis media it is equally effective.

In **erysipelas**, in which the writer has had an opportunity of employing radiant light and heat, in but 3 cases has it proved satisfactory. These cases were treated at the onset and the applications were made for one to four hours, no administration being made for less than one hour in the manner described. The result in each case was complete arrest of the erysipelatous condition. In one case the edema of the face had closed both eyes. After four hours' exposure to intense radiation—two hours in the morning and two in the afternoon—the edema disappeared. Two additional exposures on the two following days restored the features to normal.

In **acute coryza** during the past winter it has been demonstrated that applications from carbon-filament incandescent therapeutic lamps, as employed in other conditions, for from one to one and one-half hours, of radiant light in the early stage of the condition, have invariably arrested and cured the cases so treated. Likewise in **acute and subacute laryngitis**, when employed preceding the static wave current locally applied, it has been possible to arrest all cases in the early stage and to relieve advanced cases, including cases of **clergymen's and singers' sore throat**. The light in these conditions probably has a two-fold effect, one upon the circulatory condition and the other upon the germs which may be present as the exciting cause.

In **phlebitis and varicose ulcers**

radiant light and heat singly after repeated applications relieves many severe cases. When followed at each séance with a systematic application of the static brush discharge the cure is more promptly effected.

In **mastitis** before pus is formed prolonged applications of radiant light and heat will effectively dissipate the inflammation, and after pus forms, following its evacuation, they will promptly restore the condition to normal at once and completely relieve the pain and discomfort.

In small, localized **abscesses** the use of the fifty-candlepower carbon-filament incandescent therapeutic lamp, at the bedside in houses equipped with electricity, affords a means far more effective than any other method formerly employed, giving great comfort and relief in many painful and otherwise serious conditions. For such purposes it is far superior to the hot-water bag, flaxseed poultices, or other means of applying convective heat, because the effect of radiant energy penetrates deeply into the tissues, producing hyperemia in the deeper structures, whereas the effect of other local applications is, as a rule, confined to the skin.

In cases of **intestinal infection** prolonged applications of radiant light and heat in conjunction with measures employed for the removal of the intestinal contents are the most effective means, affording greater comfort and relief to the patient as well as aiding in restoring the condition to normal.

In **infantile marasmus** and the resulting emaciation the application of radiant light and heat, together with the institution of a suitable routine diet, rapidly overcomes the intestinal

inertia, restoring active function with increased peristalsis of the bowels of the little sufferers. This will be followed in most cases by rapid gain in nutrition and gradual restoration to health. This effect is due largely to stimulation of the general metabolism with increased secretion and functional activity of the intestinal glands and musculature.

In the **constipation of infants** for the same reason radiant energy plays a very important part in restoring the evacuations to normal. Through its stimulating action on general metabolism the light bath fills a most useful place, inducing, as it does, a general and active diaphoresis with elimination through the lymphatics and sweat-glands of what waste products can be carried off by those channels, and at the same time awakening general activity of the functions of the other emunctories. It is a remarkable aid in the treatment of **gout**, so-called **rheumatism**, and other toxic or anemic conditions.

In **parenchymatous nephritis** the light bath when used together with the static wave current, the latter applied over the kidneys, or the direct d'Arsonval current passed through the kidneys produces results in these cases which are truly remarkable.

In the treatment of **tuberculous affections** radiant light and heat is most effective when employed in connection with other hygienic and physical measures. The most successful routine physical treatment as systematically employed in **tuberculous adenitis** is to employ the X-ray in large doses or, more conservatively, in a series of regulated doses. After the occurrence of a superficial dermatitis or when conditions indi-

cate that the process is in abeyance, the X-ray should be followed by the use of radiant light and heat. In this connection it must be borne in mind that radiant light and the X-ray are antagonists and cannot be administered jointly for therapeutic purposes. This fact was discovered by the writer more than ten years since, and the relative effects have been frequently published by himself and others. For this reason we employ the X-ray in a series conservatively or in a massive dose, to the extent of inducing the physiological effects of inhibition, or until probable sterilization of the germs is effected. The X-ray series should then be discontinued and followed by prolonged applications of radiant light and heat. By this routine method, the germs are rendered comparatively inert by the series of X-ray exposures and the tissues, likewise, are put in a state of inhibition or lowered vitality. The subsequent application of a series of frequent and prolonged administrations of radiant light and heat induces active hyperemia with increased metabolism and circulation in the tissues. This rapidly offsets the previous inhibitory effect of the Röntgen ray and at the same time, by the increase of phagocytes produced by the hyperemia, effectively removes by phagocytosis whatever germs may have remained in the tuberculous foci.

This general principle of application employed for the treatment of all forms of tuberculosis, either pulmonary or localized, accomplishes remarkable results. Dr. Byron S. Price has reported successful results in **tuberculous peritonitis** by the employment of intense radiant light from high-candlepower tungsten lamps.

Heliotherapy in the treatment of **tuberculous arthritis** in children has proved very efficient. Applied in the open, in the higher altitudes, with the children protected, but the joints fully exposed to the direct rays of the sun, the results after a few months' treatment have been remarkable in the cases published. In **tuberculosis of the kidney** treatment by the same method as recently demonstrated promises more than has been accomplished by other methods.

In **Addison's disease**, following the Röntgen-ray treatment, light and the d'Arsonval current have proved remarkably helpful.

The antagonistic properties of radiant light and heat to the X-ray renders the administration of the latter free from the usual objections and dangers which have caused timidity with many who would otherwise have employed it to meet the many indications for which it is employed. This antagonism, as already stated, was first discovered by the writer when treating cases of malignant **lupus** and skin diseases, employing both measures on the same day. The experiment was made under the impression that the X-ray effect would be accentuated, or at least the therapeutic benefits would not be impaired; while the light might have some effect in preventing the then universally dreaded dermatitis. In 15 cases of various conditions then under treatment, the experiment being continued for nearly one month, it was found that in every case no progress was made toward improvement. Immediately upon discontinuance of the use of the light in these cases progressive improvement was again observed. This led the writer to the

conclusion that the two measures were antagonistic and that the effects of either were neutralized by the other. It was apparent that radiant light and heat would be the indicated treatment for **acute X-ray dermatitis**, and it has proved uniformly successful, the recovery being prompt in every case except in the chronic X-ray dermatitis of X-ray operators and in cases in which necrosis had already occurred.

The **postoperative use** of radiant light and heat when applied to the surface at the site of the operation is remarkably beneficial, relieving both the pain and the tenderness and at the same time promoting rapid healing. This application may be made without danger by interposing a thin covering of gauze, and continuing the application until an active superficial hyperemia is produced. Such applications will promote prompt restoration of **bruises, incisions, and macerated tissues** and afford marked relief from the **pain and discomfort** present after an operation.

In **postoperative depression with cardiac weakness**, or where some serious internal disturbance has occurred as a result of **shock** with **lowered vitality** such as may preclude an operation, prompt relief may often be afforded by application of radiant light and heat to the whole trunk of the body either by means of a high-candlepower incandescent lamp or a properly constructed one-half cylinder tube, 20 to 24 inches in diameter and 3½ to 4 feet in length and provided with numerous incandescent lights arranged in rows so that the radiations will be projected upon the nude body of the patient, the ends being closed to the neck and thighs by

sheetings to prevent the escape of the heat. By this means the deep spinal centers are reflexly stimulated from the periphery, the respiratory and cardiac centers promptly responding with increased depth of respiration and volume and strength of the pulse, except when the shock has been extreme or the vitality is at too low an ebb to respond. This method in hospital practice, and at the bedside in houses equipped with an ample electric current, may be used also with benefit in the treatment of severe infectious diseases, as **pneumonia** and **typhoid fever**, to combat depression and coincidentally limit the process of infection. Employed in this way it properly replaces cold sponges and other applications. The sweat produced evaporates and thus not only lowers the peripheral temperature, but stimulates the vital processes to greater energy in such a manner that patients *in extremis* may often be revived and saved. It will also limit the course and determine a favorable termination of many infectious conditions.

This method has been employed for several years, at the suggestion of Dr. Herman Grad, in the Women's Hospital in New York City, where it has become one of the standard methods of reviving patients in low states and has proved remarkably effective for the relief of patients suffering from septic infection.

[Dr. Grad has reported 1 case, that of a child who was brought into the Women's Hospital in a state of collapse. The light bath as described was placed over her body, when a prompt reaction and improvement was set up in her physical condition. The diagnosis of the case was rendered uncertain, the state of collapse forestalling an exploratory operation. It

was found that if the light was continued she was revived, the low condition returning if it was discontinued. The light administrations were accordingly continued for several days, when unexpectedly the child passed from the rectum several inches of the small intestine. The case had been one of intussusception. The patient made a complete recovery, which would have been impossible except for the employment of radiant light and heat during the state of collapse.

In the writer's judgment every hospital should be provided with such baths and high-candlepower incandescent lamps which can be moved about and used at the bedside of the hospital patients. There is no reason why a measure so free from all objection and of such possibilities in the treatment of local and general inflammatory conditions as the employment of radiant energy in accordance with the principles here considered should not become universal.]

It may seem to many medical men that the results outlined from so simple and available a means are impossible. It but remains for such to thoroughly test them, *i.e.*, to verify the remarkable value of light therapy.

WILLIAM BENHAM SNOW,
New York.

LIGNUM VITÆ. See **GUAIAEC.**

LIME. See **CALCIUM.**

LINUM. —Linum (linseed or flaxseed) is the dried ripe seed of *Linum usitatissimum*, the common flax. The seeds are oval and flattened. They have no odor, but a mucilaginous taste. They contain a fixed oil, wax, resin, extractive, tannin, gum, mucilage, albumin, gluten, and salts. The fixed oil is found in the interior of the seed, and when expressed without the aid of heat is known as linseed oil (*oleum lini*, U. S. P.). When ground, the seeds form a grayish meal, known as flaxseed meal, ground linseed, or linseed meal. When freshly ground the meal is rich in oil and free from rancidity.

PREPARATIONS AND DOSE. —
Linum, U. S. P. (flaxseed).

Oleum lini, U. S. P. (linseed oil), is a yellowish, oily liquid with a peculiar odor and bland taste, soluble in 10 parts of absolute alcohol, as well as in ether, chloroform, oil of turpentine, etc. Upon exposure to the air it gradually darkens, thickens, and acquires a strong odor and taste. Boiled linseed oil should not be dispensed. Dose, 1 fluidounce (30 c.c.) or less.

Linimentum calcis, U. S. P. (lime liniment; carron oil), is a mixture in equal parts, by volume, of lime water and linseed oil. Used externally.

THERAPEUTICS.—On account of its demulcent action upon mucous membranes, flaxseed has been used in the treatment of **bronchitis**, **gastritis**, **acute cystitis**, and **nephritis**, frequently in the form of flaxseed tea:—

Flaxseed, 3 drams (12 Gm.).

Extract of licorice, 30 grains (2 Gm.).

Boiling water, 10 ounces (300 c.c.).

Mix, stand in a warm place for three or four hours, and add a little lemon juice or lemon peel, sugar, and 1 to 2 drams (4 to 8 Gm.) of gum arabic. If cough is present paregoric may also be introduced.

Ground flaxseed mixed with boiling water (1 to 2½ parts) forms the well-known flaxseed poultice. It should be spread at least half an inch in thickness upon muslin or flannel, the surface covered with gauze or cheesecloth, and applied as hot as can be borne. It should be covered with thin rubber cloth to retain the heat and moisture and be renewed as soon as it *begins* to cool or dry. If a counterirritant effect is desired, the surface may be sprinkled with dry mustard or a few drops of turpentine. These applications are useful in **pneumonia** or **pleurisy** (as jacket poultice), **peritonitis**, **abscesses**, **boils**, **felons**, **inflamed glands**, **indolent ulcers**, etc. Laudanum may prove a useful addition to a poultice in painful affections.

Carron oil (*linimentum calcis*) is an old and favorite application for excluding air from **burns**.

Linseed oil, in doses of 1 to 2 ounces, may be used as a laxative and is of especial value when **hemorrhoids** are present.

W. and S.

LIPURIA. See INDEX.

LITHEMIA (uricacidemia; uricacidosis) is a condition in which, owing to defective metabolism of the nitrogenous elements, the blood becomes charged with deleterious substances, chiefly of the uric acid group. It is manifested clinically by various digestive, circulatory, respiratory, nervous, genitourinary, and cutaneous phenomena.

SYMPTOMS.—The symptoms are manifold, but may be grouped as follows: 1. Nervous symptoms: headache, paroxysmal or periodic; neuralgic pains in the bones or joints, cerebral excitement, insomnia, convulsions, and neurasthenia. 2. Digestive disorders: cyclic vomiting, colic, polyphagia, constipation, membranous enteritis, and intestinal lithiasis. 3. Urinary troubles: renal calculus and colic, albuminuria, glycosuria, dysuria, cystitis, and spasm of the bladder. 4. Respiratory ailments: coryza, sneezing, laryngitis, bronchitis, asthma, and pulmonary congestion. 5. Circulatory derangements: palpitation, tachycardia, arrhythmia, false hypertrophy, and myocardial symptoms without any lesion of the myocardium. 6. Cutaneous affections: eczema, sweating, and pruriginous eruption. 7. Various pathological disorders of the eye, ear, nose, and throat.

DIAGNOSIS.—A careful study should be made of the patient's ability to metabolize the various food elements, especially the nitrogenous and the purin-forming foodstuffs (nucleoproteids—meat, fish, fowl, eggs, peas, beans, lentils, etc.). A thorough analysis will, moreover, generally lead to correct conclusions, or at least suggest further investigations, and thereby establish the diagnosis.

ETIOLOGY AND PATHOLOGY.—

Heredity is an important factor in the etiology of the condition, and may exhibit itself in inactive liver or kidneys, incapable of adapting themselves to a particular mode of life; a digestive apparatus that, while it tolerates a surplus of food, is unable completely to metabolize it; an irritable sympathetic nervous system which responds excessively to slight disturbing causes. Incidentally, metabolism comprises two operations, anabolism (assimilation of foodstuffs) and catabolism

(retrograde changes resulting in the formation of waste products). A morbid desire for proteins and the purin-forming foods overtakes the normal metabolism and arrests oxidation at the incomplete stage of uric acid instead of at the stage of complete oxidation, urea, and the uric acid toxemia thus brought about causes a contraction of the arterioles, and a diminished capillary circulation results; in proportion as the peripheral circulation is impaired, the blood-pressure rises and, at a point in the vascular channels where the vessel walls are either intrinsically weakest or relatively weakest because of less support from extravascular tissue, engorgement must occur (hyperemia of accommodation). Stasis added to this produces inflammation, explaining all the various inflammatory phenomena produced by uric acid toxemia, except those due to the mechanical irritation of the uric acid crystals, as in arthritic gout.

TREATMENT.—In the line of prophylaxis **thorough mastication** should be enjoined. The robust, plethoric patient should take **regular outdoor exercise** with the idea of consuming his body-fats. Horseback riding, cycling, rowing, and walking are suggested. The nervous patient, on the other hand, needs **rest** and **quiet**. Wilcox advocates the constant use of **lithia water**.

Assuming that certain cases are produced by an autointoxication from the alimentary tract, and with the object of limiting fermentation, Anders recommends a **diet** consisting chiefly of **proteins**, combined with the free use of **water**. When the gastric digestion is poor, **carbohydrates** will agree better. **Cream and butter** are the only forms of fat allowed, and the use of **alcohol** is **forbidden**.

The medicinal treatment is that used in gout, to which the reader is referred. To aid the digestion of the proteins, **hydrochloric acid** may be indicated; if the appetite is impaired a **simple bitter** or **nux vomica** may be combined with the acid. W.

LITHIUM.—Lithium is one of the alkali metals, and is generally derived from lepidolite, a native silicate. It oc-

curs in minute quantities in some mineral springs. The metal is not used in medicine, but several of its salts are official.

PREPARATIONS AND DOSE.—*Lithii benzoas*, U. S. P. VIII (lithium benzoate) [$\text{LiC}_7\text{H}_5\text{O}_2$], occurs as a light, white powder, sometimes with a faint benzoin-like odor, and with a cooling, sweetish taste; it is soluble in 3 parts of water and in 13 parts of alcohol. Dose, 5 to 20 grains (0.3 to 1.3 Gm.).

Lithii bromidum, U. S. P. (lithium bromide [LiBr], occurs as a white, granular salt, with a sharp, slightly bitter taste, very deliquescent, soluble in 0.6 part of water, and also freely soluble in alcohol. Dose, 5 to 20 grains (0.3 to 1.3 Gm.).

Lithii carbonas, U. S. P. (lithium carbonate) [Li_2CO_3], occurs as a light, white powder, with an alkaline taste, soluble in 75 parts of water, more soluble in water saturated with carbon dioxide, insoluble in alcohol, but soluble in diluted acids with effervescence. Dose, 3 to 10 grains (0.2 to 0.65 Gm.).

Lithii citras, U. S. P. (lithium citrate) [$\text{Li}_3\text{C}_6\text{H}_5\text{O}_7 + 4\text{H}_2\text{O}$], occurs in a white powder or colorless crystals, with a cooling, slightly alkaline taste, deliquescent in moist air, soluble in 2 parts of water, but practically insoluble in alcohol. Dose, 3 to 10 grains (0.2 to 0.65 Gm.).

Sal lithii citras effervescens, N. F. (effervescent lithium citrate), occurs in granules and is made from 50 parts of lithium citrate, 570 of sodium bicarbonate, 300 of tartaric acid, and 195 of citric acid. Dose, 2 drams (8 Gm.), containing about 6 grains (0.4 Gm.) of lithium citrate.

Lithii salicylas, N. F. (lithium salicylate) [$\text{LiC}_7\text{H}_5\text{O}_3$], occurs as a whitish powder, with a sweetish taste, deliquescent in moist air, and very soluble in water and alcohol. Dose, 5 to 20 grains (0.3 to 1.3 Gm.).

Elixir lithii bromidi, N. F. (elixir of lithium bromide). Dose, 2 fluidrams (8 c.c.), representing 10 grains (0.6 Gm.) of lithium bromide.

Elixir lithii citratis, N. F. (elixir of lithium citrate). Dose, $1\frac{1}{2}$ fluidrams (6 c.c.), representing $7\frac{1}{2}$ grains (0.5 Gm.) of lithium citrate.

Elixir lithii salicylatis, N. F. (elixir of lithium salicylate). Dose, 2 fluidrams (8

c.c.), representing 10 grains (0.6 Gm.) of lithium salicylate.

PHYSIOLOGICAL ACTION.—Lithium carbonate and citrate, used in medicinal doses, act partly as lithium and partly as alkalinizers; the benzoate, bromide, and salicylate of lithium, on the other hand, are employed chiefly for the action of their acid constituents.

Binet has shown that lithium salts in large doses give rise in animals to the following series of symptoms: weakness, diarrhea, nausea, dyspnea, fall of temperature, convulsions, and death. The last is attributed to depression and final arrest of the heart in diastole, coupled with depression of the respiratory centers. The peripheral nervous system is paralyzed and muscular excitability reduced by lithium, which in many ways resembles potassium in its action.

Lithium salts, after absorption, are excreted in the saliva, into the stomach and bowel, and in the urine (which is rendered alkaline by the carbonate or the citrate).

Experiments have shown that lithium in large doses has the special property of causing gastroenteritis which results even if the salt be given subcutaneously, or if small doses be administered continuously by the mouth for some time.

UNTOWARD EFFECTS AND POISONING.—Lithium carbonate, in 15- to 20-grain (1 to 1.3 Gm.) doses, and lithia tablets have been known to cause gastrointestinal symptoms in man. Cleaveland, after taking rather large doses (30 grains—2 Gm.) of lithium chloride, experienced toxic symptoms when a total of 125 grains (8 Gm.) had been ingested during twenty-eight hours. There followed marked muscular and general prostration, vertigo, and eye and ear symptoms resembling those of cinchonism. There was a complete absence of gastrointestinal symptoms. Two or 3 doses (60 to 90 grains—4 to 6 Gm.) daily were sufficient to cause the toxic phenomena.

THERAPEUTICS.—The preparations of lithium at one time held a high reputation for efficiency in the treatment of the so-called "uric acid diathesis." It was claimed that they could dissolve uric acid calculi in the urinary passages or in the bladder. Haig called attention, how-

ever, to the fact that, although lithium forms a relatively soluble salt with uric acid in the test-tube, in the body it has a greater affinity for the acid sodium phosphate in the blood, the uric acid being thus left uncombined. Besides, the relatively high solubility of lithium urate has been shown to hold good only in concentrated solutions, and not to be available in solutions such as can be used in the body (Sollmann).

The carbonate, citrate, and salicylate of lithium are still used, however, in the treatment of **rheumatoid arthritis**, **gout**, and **subacute** and **chronic rheumatism**. The carbonate is but moderately soluble in water (1 to 75), and is sometimes given in freshly made pills or capsules. The citrate may be given in solution alone, in Vichy water, or in combination with other remedies. Lithium citrate, 1½ drams (6 Gm.) dissolved in 2 ounces (60 c.c.) each of spirit of Mindererus and syrup of lemon, may be given in dessert-spoonful doses every two or three hours in **rheumatism** or **gout**. Lithium salicylate, given in doses of 10 to 20 grains (0.65 to 1.3 Gm.) every three hours, has been considered especially useful in subacute rheumatism.

The lithium salts have been given in **cystitis** and **gravel** with benefit. When there is an increased secretion ofropy mucus and the urine is alkaline, lithium benzoate is to be preferred, since it renders the urine more acid; when the urine, on the other hand, is already too acid, the carbonate or the citrate should be used. Leffman asserts that if lithium carbonate is of any real value in the treatment of lithiasis it cannot be through the use of the commercial lithia waters, but the pure salt in tablet form must be dissolved in a liberal amount of distilled water.

In cases of **diabetes mellitus** with a gouty taint the use of lithium carbonate or citrate in the dose of 10 grains (0.65 Gm.), combined with ¼ grain (0.002 Gm.) of sodium arsenite given three times daily, is often followed by gratifying results (Hare).

Lithium bromide is employed for the effect of the bromine it contains, *e.g.*, in **epilepsy**. Its hypnotic power was regarded by Weir Mitchell as superior to that of potassium bromide. W. and S.

LIVER AND GALL-BLADDER, DISEASES OF THE:

DISEASES OF THE LIVER.

MALFORMATIONS.—Abnormalities in the form of the liver may be either acquired or congenital.

1. **Corset Liver.**—The constant pressure of the lower ribs against the liver as a result of tight lacing or the wearing of a tight waist-band may produce a deep, transverse furrow on the right lobe. The furrow usually corresponds to the margin of the ribs, and may be so deep that the liver becomes divided into a large upper and a small, lower, part connected by a narrow isthmus or band composed chiefly of fibrous tissue, the larger blood-vessels, and bile-ducts. The peritoneum in the groove is much thickened. The lower portion is usually rounded and may be freely movable as if hinged to the upper, and appear in the abdomen as a movable tumor.

This deformity is met with usually in elderly females. There are usually no symptoms resulting from the deformity; yet in some there is said to be a constant sensation of pressure and weight in the hepatic region. In occasional cases, owing to venous stasis, there is a temporary swelling of the isolated portion and violent pain and signs of irritation of the peritoneum.

The so-called **Oriental constricted liver** is attributed by Oshima (Sei-I-Kwai, Mar. 20, 1919) to the pressure exerted by the Japanese woman's belt, aggravated by the low sitting posture. EDITORS.

2. **Tongue-like Lobes.**—These are probably of much more frequent occurrence, and therefore of much more importance, than the corset liver. They are both of importance chiefly on account of the difficulties they present in diagnosis. Riedel met with 12 cases

of tongue-like lobes^{*} in 42 operations for gall-stones. I have met with 9 in various conditions. In 2 the mass was thought to be a movable kidney, and in 1, an infant with hemorrhagic pancreatitis, it was thought that possibly the tongue-like lobe was an intussusception. They are met with at all ages, and are probably usually congenital rather than acquired from external pressure. The diagnosis of these malformations is usually easy if the abdominal wall is thin and lax, as the connection of the mass with the liver can be definitely traced; but if the abdominal wall is thick from the deposit of fat or its muscles tense it is often impossible to differentiate these from other masses met with in the abdomen. An effort should be made to outline the mass and trace its connection with the liver. This is often impossible, as the base may be deeply furrowed and a loop of intestine may occupy the groove.

Treatment for these abnormalities is rarely called for. When the mass is troublesome from its mobility, and cannot be retained by a suitable bandage, it may be removed. Such has been done successfully.

The chief interest in this subject is in connection with the diagnosis of abdominal tumors. Unless fully alive to the great variety, as to shape and position, in which these accessory lobes of the liver may present themselves, one will often be misled in the diagnosis of abdominal tumors. In not a few cases, even with the utmost care, a positive opinion as to the nature of these tumors cannot be given.

Riedel, who first drew attention to the importance of these abnormal lobes, believes them to be due usually to pressure on the liver, as in tight lac-

ing, and to traction, by an enlarged gall-bladder. They are met with usually in women. In 9 of his 12 cases the gall-bladder was attached to the lower part of the process.

So far as can be inferred from the 9 cases which I have met, tight lacing has little to do with the production of the deformity, and the position of the gall-bladder at the lower part of the mass is an accident rather than a cause of its formation. In many, if not almost all, cases the formation of these lobes seems to be developmental, having nothing to do with either pressure or traction.

DISPLACEMENTS. — Displacements of the liver may be either congenital or acquired. As instances of the former are hernia of the liver through the diaphragm and through the anterior abdominal wall. Interesting examples are also afforded by transposition of viscera, the liver being found to the left and the spleen to the right. As a rule, the other organs, both of the thorax and abdomen, are also transposed, the cardiac impulse being in the fourth or fifth intercostal space to the right; but the liver and spleen may be the only organs abnormally placed.

There may be no symptoms, the condition being discovered accidentally. On the other hand, they may be severe, consisting of pain, tension, and dragging sensation in the normal hepatic region. Jaundice, sometimes severe, has been present in a few cases, probably due to tension or kinking of the common bile-duct. Hypochondriasis is apt to develop. The diagnosis may be difficult. Other masses—as carcinoma of the omentum, tumors of the right kidney, etc.—have been supposed to be mov-

able liver. Of the greatest diagnostic importance are the form of the tumor, its mobility, the possibility of reducing it to its normal position, the tympanitic note obtainable over the normal hepatic region before such reduction, and the dull note later.

Etiology.—Acquired displacements may be due to pressure upward by ascitic effusion, abdominal tumors, and flatulent distention, and downward by thoracic or subdiaphragmatic accumulations. These are, however, scarcely entitled to be included among liver displacements. The movable or wandering liver is of more interest. The condition is not very rare.

Graham, who studied 66 cases, concluded that displacement was found chiefly in females who have borne several children. The displacement is favored by a lax abdomen, tight lacing of the lower part of the chest, and sudden muscular strain. To render these causes effective it is probably necessary that the ligaments supporting the liver be abnormally long or weak: a condition that is doubtless congenital.

Treatment.—Treatment is not very satisfactory. A suitable **bandage** may relieve symptoms. The liver cannot be retained in the normal position by it, but further prolapse may be prevented and the liver so far supported as to relieve the pain and dragging. In a few cases the liver has been successfully sutured in position.

General massage and lypotherapy, which have for their aim the strengthening of the organism, are of high value according to Einhorn. In the front rank of all these methods is **diet rich in butter**. The patient should be directed to take as

much food as other healthy persons, and a little more. To the ordinary diet Einhorn adds $\frac{1}{4}$ pound of butter daily to increase weight. **Gymnastic exercises in the open air**, and, in cases with tendency to constipation, **special exercises for the abdominal muscles**, are likewise of value.

Literature contains 98 cases of movable liver. An injury, a severe fall or heavy lifting, or, in a few instances, the development of a malignant growth in the liver, is the usual cause. The prominent symptoms are distress and feeling of weight in the region of the liver, often considerable tympanites and intestinal indigestion, alternating constipation and diarrhea, and marked nervous symptoms (headaches, restlessness, hypochondriasis, etc.). Tight bandaging with proper tonic treatment usually affords relief. Few attempts at operative interference have been made. J. H. Carstens (Jour. Amer. Med. Assoc., May 17, 1902).

CONGESTION OF THE LIVER.

This pathological condition does not constitute a disease of itself, but is always associated with disease elsewhere, especially of the gastrointestinal tract and of the heart. The liver is particularly prone to disturbance of its circulation, because, in the first place, of its large blood-supply and, in the second place, on account of its relationship to the gastrointestinal tract on the one side and to the heart on the other. As the bulk of its blood-supply is conveyed to it by the portal vein, it will share in all the congestive disturbances of the organs drained by the portal system. The increased *inflow* of blood resulting from these disturbances constitutes an active congestion of the liver. On the other side its proximity to the heart, and the absence of valvular

structures between it and the heart render it very susceptible to any obstruction at the tricuspid orifice. Such conditions offer an impediment to the *outflow* of blood from the hepatic veins, and results in passive congestion of the liver.

Functional derangement of the liver is frequent and generally secondary to a disturbance in some other part of the organism. One of the best criteria is the presence of an increase in the vertical area of liver dullness which declines or disappears as the result of treatment. The symptoms may be enumerated thus: Coated tongue, a bitter taste in the mouth, nausea, a perverted appetite, flatulence, constipation with clay-colored stools, sallow complexion, irritable skin, dull headaches, mental depression, lassitude, insomnia, irritability of temper, drowsiness after eating, a disinclination for work, sense of weight or discomfort in the right hypochondrium, and occasionally an ache in the tip of the right shoulder. The writer believes that the chief causes of this condition of liver derangement are: Dyspepsia, gastrointestinal disturbance, alcoholic excess, rich and highly seasoned foods, fevers, nervous influences, and residence in the tropics. Bain (Brit. Med. Jour., May 18, 1912).

ACTIVE CONGESTION.—The symptoms of acute congestion of the liver are those of gastrointestinal catarrh, such as headache, malaise, foul taste, coated tongue, constipation, etc. With these may be present a sense of discomfort, weight, or even pain in the region of the liver, which may also be tender on pressure. The liver may be felt below the costal margin. There may be slight jaundice; in the severe tonic cases the jaundice may be intense.

Two cases of severe pain back of the sternum and in the upper abdo-

men due to acute congestion of the liver, greatly aggravated after climbing a hill. During the attack the liver was found extremely enlarged, reaching from the fifth intercostal space to the umbilicus, the mechanical conditions amply explaining the pain back of the sternum. The urine was concentrated, with considerable urobilin. The same clinical picture was soon presented by a third patient; the paroxysmal attack following the hill-climbing test was so severe that the patient went to bed without returning to report at the physician's office. The whole trouble was evidently extremely severe acute congestion of the liver, and the writer thinks that this is a wise effort on the part of nature to relieve the strain on the weak right heart from the physical exertion. Nature drives the blood into the liver and relieves conditions in the heart as from a venesection, giving the heart a chance to recover. Ortner (*Med. Klinik*, Sept. 21, 1913).

The urine is dark, heavy, somewhat scanty, and loaded with urates.

Diagnosis.—The diagnosis is based on the association of the symptoms of gastrointestinal disturbance, with the enlargement of the liver, besides the discomfort in the hepatic region.

Acute hepatic congestion is very common in nurslings, and not rare in older children. It may be caused by overfeeding and is often observed after trips to the mountains, seashore, etc., which excite the appetite beyond the digestive powers of the child. The stools are deficient in bile, pale and fetid, the urine dark, the liver tender and the temperature more or less raised. Raimondi (*Presse Médicale*, Nov. 19, 1917).

Etiology.—There are two main groups of causes: (1) gastrointestinal and (2) toxic. The most common of the first are catarrhal conditions of the stomach and intestines resulting from undue indulgence in

food, and drink, especially if of a stimulating nature, as spices and alcohol. The habitual use of spirits to excess furnishes the most marked examples in these northern climates. Persons of sedentary habits are more liable to be affected, especially at middle age. Toxic causes occur in infectious diseases, especially in malaria, dysentery, typhoid fever, yellow fever, etc. Even these causes act chiefly through the gastrointestinal tract. They are much more common in tropical climates.

Active congestion of the liver is also met with in suppressed menstruation and in diabetes mellitus. In both of these it has been attributed to vasomotor disturbance, but in diabetes the increased work thrown on the liver may be the chief cause.

Morbid Anatomy.—The liver is enlarged, dark in color and the vessels full of blood. The distention of the lobule with blood is not limited to the center, but is general. There is often some fatty change in the liver-cells.

Treatment.—The indications are chiefly two: (1) to correct the habits that have mainly caused the condition and (2) to relieve the gastrointestinal condition and the hyperemia of the liver. We aim at attaining both objects simultaneously. The diet should be of the blandest nature. In severe cases no food should be given until the bowels are acted on and the portal system depleted by a brisk laxative. Water should be taken freely on an empty stomach. The food should be regulated according to the needs of each case so as not to tax the digestive powers. Exercise should be free, but without undue fatigue.

Where hepatic congestion is the result of heart disease the first indication is to lower the venous blood-pressure by **venesection**, **wet cupping**, or by drastic or saline **cathartics**. For the first six to twenty-four hours, according to the intensity of the symptoms, only **boiled water** should be given, then **milk** diluted with boiled water, and finally milk alone, to the amount of $1\frac{1}{2}$ liters (quarts) a day, gradually increased to $2\frac{1}{2}$ liters. The administration of **digitalis** is started at the same time. Diuresis may be continued with doses of $7\frac{1}{2}$ grains (0.5 Gm.) of **theobromine** three times a day. Copious **intestinal irrigations** with cold boiled water, **alkalies**, **saline purgatives**, **cholagogues** in small doses, and **tub baths** followed by **massage** of the whole body may be given. Where there is cardiac enlargement **digitalis** may be replaced by the following combination:—

℞ *Ext. ergotæ*,
Pulv. scillæ,
 aa gr. iss (0.1 Gm.).
Hydrarg. chlo-
 ridi mitis gr. $\frac{3}{4}$ (0.048 Gm.).
Pulv. digitalis . gr. $\frac{3}{8}$ (0.024 Gm.).

M. et ft. pil. no. j. Ft. tal. no. xxv.
 Sig.: One pill three times a day.

Vires (Jour. des prat., Mar. 6, 1912).

If **douching over the liver** is applied properly, it is one of the most effective means in diseases of the liver and gall passages. It has, of course, no influence upon the cirrhotic tissue and atrophy, but will produce good results in hyperplastic, hypertrophic, and congestive conditions and bile stagnation, jaundice, dull pains, and mild colics. The treatment requires first a general warm (100° - 113° F.) rain and then a movable spray of the same temperature upon the liver region until the skin is decidedly red, followed by a cold or alternate (cold and warm alternately) jet for ten to thirty seconds upon this organ. Raymond and Duchesne (Dietet. and Hyg. Gaz., Mar., 1908).

PASSIVE CONGESTION OF THE LIVER.—Passive congestion. of the liver (*nutmeg liver*, *cardiac liver*,

red or cyanotic atrophy of the liver), is a pathologic condition caused by obstruction to the outflow of hepatic blood.

Symptoms.—The symptoms are chiefly those of the condition of the heart and lungs causing the hepatic congestion. There may be a sense of weight and fullness in the right hypochondrium, aggravated by external pressure, deep inspiration, and by lying on the left side.

Enlargement of the liver is one of the chief signs and is usually best demonstrated by palpation. When large, the liver can often be delimited by inspection. Percussion is usually unreliable on account of distention of the intestines.

Pulsation of the liver is often present in severe cases; it disappears when the induration develops and the heart becomes weak. I have seen it persist in cases of initial stenosis until within a few weeks of death.

Gastrointestinal symptoms are always present. They result from the portal congestion induced by the hepatic obstruction. They consist in disturbed digestion, and, often, hemorrhoids.

Ascites is frequent. In the early stage it occurs as a part of general dropsy. Later, when the liver becomes indurated it is increased by the portal obstruction. Jaundice is usually present, and is a definite symptom in the advanced cases. It is probably secondary to the gastroduodenal catarrh. It is usually most marked in the cardiac cases, and, with the cyanosis existing in such cases, it causes a peculiar dusky green tint.

The urine shows high specific gravity and is scanty.

Etiology.—The causes leading to this condition are such as lead to inter-

ference with the free flow of blood through the heart, and include, therefore, all changes in the heart and lungs which tend to render the right ventricle incompetent. Of the cardiac conditions the most common is mitral disease, especially stenosis; but all heart-lesions, whether of the valves or of the substance of the heart, tend to impede the venous flow by ultimately overtaxing the right heart. Such diseases of the lungs as emphysema, asthma, chronic bronchitis, etc., are also frequent causes of dilatation of the right heart, and thus lead to obstruction to the hepatic outflow.

Deformity of the spine, pleuritic effusion, aneurism, and intrathoracic tumors may obstruct the flow of blood through the heart and lungs or press upon the vena cava directly.

Occasionally a local lesion, as perihepatitis, may compress the hepatic veins themselves or the vena cava and obstruct the outflow from the liver.

Morbid Anatomy.—In the early stage there is great engorgement of the hepatic veins and their intralobular branches and capillaries. The liver may become much enlarged, its lower border extending in time to, or even below, the umbilicus. If the obstruction be removed before organic changes have occurred in the liver, the vessels rapidly empty themselves, and the liver returns to its normal size. Even after long-continued congestion the liver may be much smaller after death, unless escape of the blood from the hepatic veins is prevented by distention of the right ventricle.

Persistent hyperemia leads in time to structural changes. As the intralobular veins are greatly dilated, the liver cells around them atrophy from pressure,

and blood-pigment is deposited. The center of the lobule becomes dark, contrasting strongly with the periphery, which becomes yellowish, on account of fatty degeneration of its cells; hence the "nutmeg"-appearance of the section of tissue.

A careful histological study showed that passive congestion of the liver occurred in five different types: (1) Capillary dilatation with atrophy of central cells, found in moderate circulatory disturbances of various kinds; (2) central degeneration with or without congestion, a stage of degeneration slightly more advanced than the preceding; (3) central fat accumulation with hyperemia or necrosis, a peculiar type usually found in the young in acute rheumatic fever; (4) central necrosis usually associated with hemorrhage, the advanced nutmeg lesion described by Mallory; (5) collapse fibrosis or cardiac cirrhosis. This last condition is more apparent than real, there being little if any increase in the amount of connective tissue originally possessed by the liver. The important factors which lead to the various changes in the liver substance are blood stasis, tissue asphyxia, interstitial hemorrhage and autolysis. The actual effect of the blood-pressure upon surrounding tissues appears to be slight. Lambert and Allison (*Bulletin Johns Hopkins Hosp.*, Dec., 1916).

In course of time atrophy of the liver cells is succeeded by increase of connective tissue. Shrinking and induration result, and may lead to considerable reduction in the size of the liver.

Treatment.—The treatment is chiefly that of the condition of the heart or lungs that causes it, at the same time endeavoring to relieve portal congestion. The latter is usually effected by the action of cathartics. A more rapid effect may be

obtained by local depletion with **leeches**, 5 or 6 being applied over the liver. Their application is usually attended by marked relief when there is pain and distress in this region.

Rest is an important feature of the treatment owing to the decreased heart action that attends it.

Calomel, in repeated doses, is not only an active cathartic, but also an efficient diuretic in such cases. **Digitalis** may be combined with it to increase the power of the heart and secure greater diuretic effect. The condition of the heart requires the administration of heart-tonics, as **digitalis**, **strychnine**, etc. Vegetable cathartics—as **podophyllin**, **colocynth**, **jalap**, **aloes**, etc.—may be used, or salines, such as **sulphate of soda**, **sulphate of magnesia**, or the natural purgative waters (such as **Apenta** or **Hunyadi**, **Rubinat**, **Hawthorn**, **Friedrichshall**), etc.

A combination of **sodium salicylate** and **sodium benzoate** is useful as cholagogue and for "flushing-out" effects in various disorders. Sodium salicylate induces flow of concentrated bile; sodium benzoate, of dilute bile. Relative amounts of two salts to be varied according to indications. Formula suggested: **Sodium benzoate**, 0.75 Gm. (12 grains); **sodium salicylate**, 0.5 Gm. (8 grains); **sodium borate**, 0.25 Gm. (4 grains); **rhubarb**, 0.3 Gm. (5 grains); to be taken *t. i. d.* **Polain-Cartier** (*Revue de thérap.*, Oct. 1, 1911).

PERIHEPATITIS.—This consists in an inflammation of the peritoneal capsule of the liver. Inflammation of the fibrous capsule apart from the peritoneal occurs only as secondary to interstitial hepatitis.

Inflammation of the peritoneal covering of the liver may occur either as a part of general peritonitis or as

a local disease. It may be acute or chronic, the former being usually suppurative while the latter is always fibrinous or adhesive.

ACUTE PERIHEPATITIS; SUBPHRENIC ABSCESS; PYOPNEUMOPERIHEPATITIS.—**Symptoms.**—The development of the disease may be with striking symptoms suggestive of perforative peritonitis of the upper part of the abdomen, or it may be so insidious as not to attract attention until the abscess has attained a large size.

Pain in the right hypochondrium or epigastrium is the most prominent symptom. It is increased by pressure and movement; hence the respiration is shallow and costal. Fever, often ushered in by a chill, is present; it may be quite remittent. There may also be abdominal distension, vomiting, hiccough, slight jaundice, weak pulse, etc.

A history of recent appendicitis or liver trouble may give the clue when there are no local subjective or objective signs of the abscess, the general condition does not improve as rapidly as anticipated, and fever drags along after the primary affection is supposedly conquered. Only rarely is subphrenic abscess ushered in with a chill, high fever, and pain. In the subacute cases there may be pain in the intercostal spaces or below the costal arch; the side involved does not share in the breathing excursions as much as usual. Percussion reveals a zone of relative dullness which in front has a cupola-like outline. The liver seems to be pushed down, the heart up. Accumulation of gas in the region is revealed by resonance between the lung and liver, changing its location as the patient changes position. Röntgenoscopy shows the diaphragm abnormally high, and reveals accumulation of gas, but if the pleura is involved the röntgenoscopic find-

ings may be misleading. If exploratory puncture brings pus, the indications for operative treatment are given at once. By introducing and withdrawing the cannula very slowly, there is less danger of missing the abscess; it may be necessary to puncture at several points before the pus is discovered. The writer is confident that if the space just below the diaphragm is examined more as a routine measure, the findings will clear up many puzzling cases and suggest effectual treatment. He reports several cases from his own experience in which the subphrenic abscess developed after operative treatment of perforation of a gastric or duodenal ulcer. In the majority of cases the appendix was the primary seat of trouble. In differentiating subphrenic abscess, empyema, pyopneumothorax, pulmonary and liver abscess, and liver echinococcus cyst are the affections which have to be excluded. G. Ledderhose (*Deut. med. Woch.*, July 31, 1913).

The physical signs presented will depend largely on the size of the abscess. In the beginning there may be a friction rub. If the abscess is large there is presented great fullness in the right hypochondrium, with extension upward of hepatic dullness, even to the angle of the scapula, and of the edge of liver downward, it may be, to the umbilicus. The upper limit of dullness is convex toward the thorax, following the curve of the diaphragm. Over this area there is absence of all respiratory signs. The course of acute perihepatitis, in the absence of suppuration, may be rapid, recovery taking place in a few days; in suppurative cases it may be prolonged for months with all the symptoms of chronic suppuration, as irregular temperature, sweats, loss of flesh, etc. In many cases fistulous openings take place through the dia-

phragm, causing a localized empyema, which, in time, perforates the lung into a bronchus, with abundant purulent expectoration, or externally through an intercostal space. In others the abscess discharges into the stomach or intestine. The general course of subphrenic abscess resembles that of empyema or abscess of the liver. The result is usually fatal, unless efficient drainage be established. In all the cases recorded only about 20 patients have recovered.

Diagnosis.—In subphrenic abscess the signs are so indefinite that a diagnosis is only exceptionally made. The abscess is usually mistaken for empyema. A history of disease of the stomach, duodenum, or gall-bladder would indicate a perihepatitis, as would also a history of abscess from appendicitis. The absence of a history of intrathoracic symptoms—such as cough, expectoration, etc.—renders pleuritic disease improbable.

The intraperitoneal form, much the most common, is usually on the right side, but 6 left-sided cases have been reported, 1 of these in the present paper. Subphrenic abscess may follow appendicitis when there has been no suppuration about the appendix, and it is often impossible to trace any purulent tract between the abscess and the appendix. It rarely occurs as the result of a general suppurative peritonitis. In the majority of cases the appendix is retrocecal and a persistence of the embryonal position of the appendix, due to non-rotation of the cecum and bringing it into close contact with the right lobe of the liver, also favors the formation of subphrenic abscess. In the acute form the pain, nausea, and other signs of an acute infection are not always marked; the persistence of a high temperature, with or without accompanying signs of septic infection, is

the most characteristic symptom. Eisendrath (*Jour. Amer. Med. Assoc.*, Mar. 7, 1908).

The physical signs are those of massive enlargement of the liver; if the abscess cavity contains air, the signs of movable dullness and tympany of pneumothorax are added. However, the bulging of the right side is greater below the diaphragm rather than above. The diaphragm may be pressed upward to the third, or even the second rib, but, however high it is, its limits are well defined and above it the respiratory sounds are not obscured. The lower border of the liver may be greatly depressed. The heart is not as much displaced as it is in pleural effusion.

On exploratory puncture, if the pus is reached, the spurting is most forcible on inspiration, owing to the descent of the diaphragm. This would practically be conclusive evidence of the seat of the abscess. The presence of bile pigment in the pus would also indicate that the abscess is below the diaphragm.

This may occur in one of five ways: As a localized abscess, a part of general purulent peritonitis; by extension of the diseased process from the appendix to the subphrenic region by an intraperitoneal route; by extension of the diseased process by an extraperitoneal route, either by way of the lymphatics or by infiltration through the retroperitoneal tissue; by way of the blood-current as part of a general embolic septic process; or as a sequence of liver abscesses of embolic origin by way of the portal vein. Christian and Lehr (*Medical News*, Jan. 24, 1903).

The leucocyte count differentiates hyperemia of the liver from amebic abscess, according to the writer, as shown in 22 cases. When there is actual suppuration there is increasing leucocytosis but no eosinophils and

scanty lymphocytes. The mononuclears decrease while the neutrophils increase. There is considerable shifting to the left in the Arneth scale. All these changes are progressive. In mere hyperemia, reverse conditions prevail and remain stationary. Neeb (*Mededeel. d. Burg. Geneesk. Dienst*, 2, 1920).

Etiology.—It occurs occasionally from a blow or direct injury. It is usually secondary to disease in some adjacent part of the liver itself, such as: Perforating ulcer of the stomach or duodenum, perforation of the gall-bladder, perforation of the intestine or the appendix; abscess of, or in the region of, the kidney, spleen, or appendix; suppuration in the right pleura, the pyogenic organisms making their way through the diaphragm by the lymphatics; abscess of the liver, echinococcus cyst of the liver, suppurative cholangitis, etc., general peritonitis, and traumatism.

Analysis of 76 cases of subphrenic abscess showed that about one-third of the cases were due to perforating gastric and duodenal ulcers. In the majority of the cases due to gastric ulcer the perforation was on the anterior wall of the stomach and near the lesser curve. The septic matter escaped direct into the left anterior intraperitoneal space and the abscess was localized there. About one-sixth of the cases were due to appendicitis. Barnard (*Brit. Med. Jour.*, Feb. 22, 1908).

Morbid Anatomy.—In the early stage the peritoneum of the liver and of the corresponding part of the diaphragm presents the signs of inflammation. The inflammation at the margins of the affected area being less severe, adhesion of the opposing surfaces takes place, while the exudate in the central part, being rich in leucocytes, liquefies, and an

abscess results. The abscess may be small or so large as to contain a quart or more of pus. The pus may be creamy and odorless, but more often it is fetid and contains necrotic tissue. It may be dark red from admixture of blood or green from bile. Occasionally air or gas is present, even when no communication with a bronchus or with the stomach or bowel can be found. These abscesses are found usually between the right lobe of the liver and the diaphragm, but may be over the left lobe.

Study of 28 cases of suppurative hepatitis admitted to the Presbyterian Hospital, New York, the past twenty years. The infection reached the liver by way of the portal vein in 17 cases; by way of the hepatic artery in 3 cases; by way of the bile passages in 3 cases; unknown in 6 cases.

Of the first 17 cases, lesions of the alimentary tract were found in 10 cases *post mortem*, while the other 7 showed evidences of intestinal lesions. In not a single case were amebæ coli found in the stools or hepatic abscess. A general pyemic process attended the portal-vein cases, 2 of them being secondary to malignant endocarditis and the third following puerperal sepsis.

In the 3 cases due to occlusion of the biliary passages, the common duct was occluded in 2 cases by a calculus. The 28 cases had fever of an irregular type with chills. Icterus was present in only 6 cases. Pain and tenderness over the hepatic region were usually present. Stuart Hart (Presbyterian Hosp. Reports, vol. iv, p. 150, 1900).

Treatment.—In the early stages the aim of treatment should be to secure relief from pain and arrest of the inflammation. This is best effected by **rest in bed**, the application of 5 or 6 **leeches** over the seat of disease, and the hypodermic injection of **morphine**. Purging freely by

salines may be of much benefit. Useful, but less effective, means than leeching are the local application of **heat, poultices, sinapisms, or blisters**. As soon as the formation of pus can be determined, **free drainage** should be resorted to. This may necessitate the **resection** of one or more **ribs**, but in any case the drainage should be as complete as possible.

Case of subphrenic abscess and recovery after **drainage** through the abdominal wall. The case was complicated by an effusion of serum into the pleural cavity, which was removed by the **aspirator** on several occasions. Campbell and Wood (Brit. Med. Jour., March 23, 1901).

Case in which a subphrenic abscess on the left side was correctly diagnosed and cured after **resection of the eleventh rib**. The abscess cavity contained about 150 c.c. of creamy, yellow pus without bad odor or gas, which contained staphylococci. Examination with the finger showed that the cavity was smooth walled, extended beneath the diaphragm, and permitted the softer walls of the stomach and intestine to be clearly distinguished from the harder spleen. Meisel (Munch. med. Woch., July 13, 1909).

One of the main causes for failure of **operative treatment** is the non-recognition of the abscess when conditions are found otherwise deemed sufficient to explain the symptoms observed. Jeannel made a gastro-enterostomy to remedy disturbances from stenosis of the pylorus, overlooking a subphrenic abscess which was found at autopsy in the angle between the ribs and the ensiform process. In two or three other cases a pleural effusion and appendicitic abscess were drained, but autopsy revealed an unsuspected subphrenic abscess of gastric origin. The most common cause of postoperative fatalities is the existence of a second, unsuspected abscess; such mistakes are not always

avoidable. Guibal (*Revue de chir.*, Mar., 1909).

CHRONIC PERIHEPATITIS.—

This condition may be local or general. *Local* perihepatitis is always secondary. It is seen, for example: Around the gall-bladder in some cases of gall-stones; over a tumor in the liver; at the point of adhesion to the liver of an ulcerated stomach or intestine; as the result of a local tuberculous or carcinomatous deposit; and in many cases of venous obstruction whether from cardiac or pulmonary disease. It may result also from pressure, as in the furrows produced by tight lacing or constriction of the liver from any cause.

General perihepatitis is a very different condition. W. Hale White gives a valuable account of the condition based on the records of Guy's Hospital. In it "the whole capsule becomes thick, opaque, and white, . . . easily peels off the subjacent liver, the surface of which is smooth; and for some unexplained reason it is quite common to find the inferior edge folded up on to the anterior surface of the liver." This thickened capsule is often pitted deeply. The liver is usually slightly atrophied, but otherwise little altered. The thickened capsule does not seem to cause pressure upon the vessels at the transverse fissure. The capsule of the spleen and the general peritoneum are usually also thickened. The omentum may be thickened and contracted, forming a tumor across the abdomen.

Of the 22 cases analyzed by White in 19 there was chronic granular kidney, and he thinks the chronic peritonitis and general perihepatitis should be regarded as a sequel to the

renal disease. Ascites, resulting probably from the chronic peritonitis, is nearly always abundant and requires repeated tapping. These cases are doubtless frequently looked upon as cirrhosis of the liver. Further study of the condition is much needed.

Antipyrin salicylate, in 10-grain (0.65 Gm.) doses, given every two to four hours, relieves the symptoms of chronic universal perihepatitis, and limits the duration of the exacerbations to a very few days or sometimes hours. Usually at the expiration of thirty hours the patient regains his normal condition. Wilcox (*Mthly, Cyclo. and Med. Bull.*, July, 1911).

JAUNDICE (ICTERUS).

DEFINITION.—This is not a disease, but only a symptom group, occurring under a variety of conditions and characterized by a yellowish discoloration of the skin, tissues, and fluids of the body with bile pigment, and the excretion of the pigment in the urine.

It has been customary to classify all cases of jaundice into the two great groups of obstructive and non-obstructive jaundice, but, the more thoroughly the pathology of the condition is investigated, the greater is the number of non-obstructive cases that are found in reality to be obstructive, and in time it is probable that in all conditions jaundice will prove to be obstructive in origin.

William Hunter originally designated the two groups of jaundice as *obstructive* and *toxic*; these seem to be the most suitable terms at present available. The obstructive group includes all cases dependent on palpable obstruction; and the toxic those occurring in connection with some general infection. Even what

is characterized as the toxic hemolytic or hematogenous form of jaundice is now (1914) recognized as in reality obstructive in character.

Jaundice resulting from mental emotion, usually of a depressing nature, cannot be placed in either group; its nature is quite uncertain. Numerous cases due to shock have, however, been reported.

Jaundice from suppression of liver function cannot now be accepted as possible, as bile pigment can only occur as the result of hepatic cell activity. Further, the removal of the liver or the complete severance of its connections by ligature does not cause jaundice.

Blood-serum is found stained in icterus, even in the mildest grades and though the urine at the time show absolutely nothing. The early diagnosis of icterus often cannot be made by an examination of the urine. A simple and accurate method for making the diagnosis is to puncture the ear or finger and to fill several capillary tubes, $1\frac{1}{2}$ mm. in diameter and 10 mm. long, with blood; then to close the tubes at each end with sealing wax, place them vertically, and observe them after a few hours, when the serum and blood will have become separated. A yellow tinge to the serum is an early and important indication of jaundice. Hamel (*Deut. med. Woch.*, Sept. 25, 1902).

OBSTRUCTIVE JAUNDICE (HEPATOGENOUS JAUNDICE; EXTRAHEPATIC JAUNDICE).—

This type includes the cases due to mechanical obstruction in the hepatic duct or common bile-duct, irrespective of any changes of the blood or bile. As originally classified by Murchison, its causes are as follows:—

1. Obstruction by foreign bodies within the duct, as gall-stones, inspissated bile, parasites, etc.

2. Obstruction by inflammatory tumefaction of the duodenum, or of the lining membrane of the duct and exudation into its interior.

3. Obstruction by stricture or obliteration of the duct, as may result from perihepatitis, or from a cicatrix in the duct or at its mouth in the duodenum.

4. Obstruction by tumors closing the orifice of the duct or growing into its interior.

5. Obstruction by pressure on the duct from without by (a) enlarged glands, (b) hepatic tumor, (c) tumor of the pylorus, (d) tumor of the pancreas, (e) tumor of the kidney, (f) omental tumor, (g) an abdominal aneurism, (h) fecal accumulation in the colon, or (i) ovarian or uterine tumors.

Conclusions based on 600 operative cases of jaundice: 1. In about 80 per cent. of the cases the first attack of gall-stone colic manifests itself as a simple or infected hydrops of the gall-bladder. In about 20 per cent. of these patients bile is present in the gall-bladder. 2. About 57 per cent. of the cases have a primary, large, occluding calculus in the gall-bladder neck or in the cystic duct; 43 per cent. have smaller calculi above these points. The former patients usually suffer with ineffectual attacks, the latter frequently, although their attacks may be more or less effectual, or even completely so, if the calculus passes into the common bile duct or into the duodenum. 3. Ineffectual attacks in which the stone remains quiescent in the gall-bladder neck or in the cystic duct are unassociated in 90 per cent. of the cases with icterus. The majority of the patients, therefore, have no icterus during their first attacks of gall-stone colic. 4. In 10 per cent. of the ineffectual attacks icterus ensues even when the calculus remains passively in the gall-bladder neck or in the cystic duct. This jaundice is of an inflammatory and mostly

septic type. It originates through an extension of the inflammation to the bile passages of the liver or to the liver structure itself. In cases of calculi situated high up in the hepatic duct, with displacement and kinking of the duct, a mechanical factor is added to the inflammation. 5. Even during the first of a series of violent attacks an occluding calculus may become impacted in the common duct, but more frequently smaller stones which have been located high up in the cystic duct are forced backward, and under these circumstances a true lithogenous icterus develops, usually of infectious origin. Riedel (Deut. med. Woch., Nu. 8, 1910).

General Symptoms.—The color of the skin varies according to the intensity and duration of the jaundice. In cases of catarrhal jaundice with sudden obstruction the surface becomes rapidly stained a deep yellow. When jaundice has existed for a considerable time it changes to a greenish hue, which gradually passes into a dark-olive color, doubtless on account of the action of the air on the bile pigment in the skin. This very dark color, known as "black jaundice," though not pathognomonic of cancer in the liver, is rarely produced by any other disease. The icteric hue shows most distinctly on the pallid parts and to a much less degree on highly-colored parts, as the lips, florid cheeks, mucous membrane of the mouth, etc. We, therefore, look to the conjunctivæ for the first signs of icteric discoloration.

Many of the secretions are also colored with bile pigment. The sweat is yellow and stains the patient's linen. The tears and milk may also be colored, but the saliva is not stained nor do the secretions of the mucous membranes, not even of the bile-ducts and gall-bladder, contain any bile.

Inflammatory exudates, as the sputa of pneumonia, are bile stained, as are

also the exudates into the various serous cavities.

Since the removal of diffusible substances in the blood is chiefly by the kidneys, it follows that the urine contains more of the biliary coloring matter than any other secretion. It may be present in the urine even before it appears in the conjunctivæ. The color of the urine may vary from a barely perceptible greenish-yellow to a dark-brown or even black color. Bile pigment is invariably present in the urine in jaundice, except in chronic cases in which the obstruction to the bile flow is suddenly removed, when the icteric hue of the skin will persist after the blood has been cleared of the bile pigment. Bile-stained urine foams readily when shaken, and the froth is of a yellow color. Rhubarb and santonin, when administered, produce a similar color in the urine, but the froth is not yellow; the addition of caustic potash causes a red coloring of the fluid and the tests for bile pigments are not obtained.

Gmelin's test is usually employed to determine the presence of bile pigment, but it may fail to give a reaction even in the presence of 5 per cent. of bile. It is best made by placing a few drops of common nitric acid and of the urine on a white, flat surface and then causing them to run together. A play of colors results at the margin of contact, rapidly passing through various shades of green, blue, violet, and red, finally becoming a dirty yellow.

The following modification of it is much more delicate, revealing even 0.2 per cent. of bile, and should be employed in doubtful cases: "To 50 c.c. of urine add 5 c.c. of 10 per cent. barium chloride solution and 5 c.c. of chloroform. Shake for several minutes. Set

aside for ten minutes. The chloroform and precipitate of phosphates fall down, carrying with them all the bile pigment. Now draw off the chloroform and the precipitate with a pipette. Place in a flat dish, and set over a basin of hot water until all the chloroform has evaporated. Allow to cool and pour off any fluid from the precipitate. The latter will be yellowish. Place impure nitric acid in drops here and there on the surface of the precipitate. If bile pigment is present a play of colors appears round each drop." ("Clinical Methods," by Hutchinson and Rainy.)

The stained cellular elements in the urine afford a reliable test for the presence of bile pigment. In chronic cases the urine may contain albumin and pigmented tube casts. In those slight forms of jaundice in which bile pigments do not appear in the urine in appreciable quantity the spectroscope furnishes a very delicate and accurate test.

Hedenius's Test.—The following recommended as a simple method of detecting bile pigment in icteric fluids: To about $1\frac{1}{4}$ fluidrams of serous fluid add twice or thrice its volume of concentrated alcohol, and shake the mixture. Add as many drops of hydrochloric acid (10 to 25 per cent.) as will be required to dissolve the precipitate caused by the addition of the concentrated spirits, when the fluid will become clear. Bring the fluid to a boil, and if bile pigment be present a blue-green color will appear within a minute or so. In a serous exudation containing only 1 part of bilirubin to 250,000 parts of fluid, the blue-green color became very conspicuous. When it is desired to ascertain the presence of an insignificant quantity of the coloring matter of the bile in concentrated fluids

rich in albumin, the author proceeds as follows: To $\frac{3}{4}$ or 1 fluidram of the fluid add 4 or 5 times its volume of concentrated spirit, which will cause the precipitation of all the proteid substances present. Shake well several times and filter the fluid. Add several drops of hydrochloric acid and boil, when, if bile pigment be present, a delicate blue-green color will appear.

Jaundice may be distinguished from the yellow hue caused by malaria, cancer, lead poisoning, and some kidney affections, according to Inglis, by placing a few drops of the urine in a porcelain dish and causing a couple of drops of nitric acid to flow against it. If bile pigment be present, a greenish tint will result, followed by blue, violet, and a yellow or brown.

Ehrlich's aldehyde test for urobilinogen—which is due to transformation of bile in the intestine, largely by the action of bacteria, and which can appear in the urine only with disturbed action of the liver-cells—and the **galactose tests** of liver function are as follows: "A stock solution is made with paradimethylaminobenzaldehyde, 4 Gm., or 2 per cent.; hydrochloric acid, 40 Gm., or 20 per cent.; water and a few drops of alcohol, to 200 c.c. One or 2 drops of this solution are added to 5 c.c. of fresh urine. In the presence of urobilinogen there develops, usually in the first few minutes, a rose-red color. Exceptionally, the extreme depth of color is not reached until one-half to two hours have elapsed. The reaction is somewhat more common in dark than in light colored urines. In a dark, bile-laden urine bile pigments obscure the test. The urine with the reagent is then shaken with a few drops of chloroform, when the red color appears in the chloroform at the bottom of the test-tube." The **galactose test** is given as follows: Forty Gm. of milk-sugar are given in tea in the morning after free purgation. In

cases where the liver-cells are diseased, instead of a trace or a small amount of sugar in the urine, from 4 to 10 Gm. of galactose are eliminated by the kidneys and can be detected by Fehling's and Haines's tests; the amount is large from three to six hours and continues from ten to fourteen hours. The urobilinogen test is a very delicate test for impaired liver function. Any localized diseased cells will let pathological amounts of urobilinogen pass to the urine.

The galactose test is a general functional test. Galactose is not passed in localized hepatic diseases when the remaining part of the liver has good compensatory function. In the various forms of cirrhosis the galactose test is uniformly positive, strongest in alcoholic cirrhosis. In septic conditions or advanced stages of infectious diseases a positive galactose test results from liver degeneration. In cases of phosphorus poisoning, chloroform and mineral poisons, liver degeneration is not shown by the galactose test until some days after administration of the poison; in phosphorus poisoning, sometimes not until the second or third week. The great value of these tests for differential diagnosis lies in the conclusion which can be drawn from their combined use. I. C. Chase (Jour. Amer. Med. Assoc., Aug. 3, 1912).

As no bile enters the intestine, the feces are pale or clay-colored, on account of the large amount of fat present. They are pasty and usually fetid. Strümpell holds that the clay color of the stools is due to the undigested fat, and in jaundiced patients who are fed on fat-free food this peculiar odor is not present. There is usually constipation, but diarrhea is not infrequent, owing to the decomposition in the intestines. There may be no derangement of the stomach, but often there is loss of appetite, coated tongue, foul taste, fetid breath, and epigastric fullness after food.

Alimentary galactosuria is a constant symptom of catarrhal jaundice and cirrhosis of the liver, while in normal individuals and a great variety of diseases it is lacking. The writer gives 40 Gm. (1½ ounces) of galactose in 400 to 500 c.c. (¾ to 1 pint) of tea early in the morning on the fasting stomach, and then estimates quantitatively the amount of galactose which reappears in the urine. In jaundice due to gall-stones and to malignant disease it is usually absent, and, when present, is very slight. Because of the difficulty of diagnosis and prognosis in many cases the method may be of value. Bauer (Deut. med. Woch., Bd. xxxiv, S. 1505, 1908).

The writer opposes the view that the albuminuria of icterus is due to the retention in the blood of bile constituents. Hemic toxic substances damage the parenchyma of both liver and kidneys and hence set up both jaundice and albuminuria. Höjer (Hygeia, Dec. 30, 1917).

Slow pulse is very characteristic; it is usually from 40 to 60, but may be down to even 20 per minute. Such pulse changes are more frequent in catarrhal jaundice and are not usually of unfavorable significance. The respirations are usually normal, but may fall to 10 or less per minute.

In many protracted cases there is a marked tendency to hemorrhages, especially to purpura and to subcutaneous extravasations. The blood requires in some cases eleven or twelve minutes to coagulate instead of three or four, as in normal states (Osler).

Surgical operations should only be undertaken in case of chronic obstructive jaundice with due regard to this change in the blood.

The persistent and uncontrollable capillary hemorrhage so often occurring in operations on deeply jaundiced subjects is especially likely in malignant bile-duct obstruction. Berg (Annals of Surg., Sept., 1903).

Pruritus is often a distressing symptom in the chronic forms of obstructive jaundice. It occasionally precedes the onset of the jaundice. It is worse at night and may be general or localized. Scratching gives rise to various eruptions. Sweating is frequent. Urticaria, lichen, and boils may be present, as may also xanthelasma.

Three cases of jaundice in which itching was the first symptom, showing that the itching is not due to a deposit of bile pigment in the skin, but in all probability is caused by some metabolic poison. When itching exists for which no cause can be found, the liver as a possible factor should not be overlooked. Preicteric itching is suggestive, though not pathognomonic, of the existence of malignant disease involving the liver or the biliary passages. Riesman (Amer. Med., Feb., 1907).

In pregnant women an afebrile course, slow pulse, and only slight disturbance of the general health are signs that the jaundice is of a mild form. The behavior of the pulse is the main criterion for the prognosis. Simple mild jaundice in the pregnant woman does not seem dangerous for the child; in one such case reported jaundice for six months owing to obstruction of the common bile-duct by a stone did not affect the fetus unfavorably, so far as could be discovered. If the child suffers from the jaundice the primal cause underlying the jaundice must be responsible or some complication. The intoxication causing the insufficiency of the liver or infection or fever or existing nephritis or syphilis is the factor injuring the fetus and not the bile acids. Rissmann (Zeit. f. Geburtshilfe u. Gynäk., Bd. lxx, Nu. 2, 1909).

Cerebral symptoms may be marked, including irritability, great despondency, and even melancholia. There are often headache, vertigo, and dullness; there may be sleeplessness. The

vision may be affected in various ways; there may be nyctalopia, or improved vision in obscurity; objects may appear yellow or there may be hemeralopia, or very difficult vision.

Specially severe symptoms may develop in persistent jaundice and quickly prove fatal. Usually there is slight fever, rapid pulse, emaciation, and mild delirium. From this typhoid state the patient may soon become comatose or develop convulsions. This condition was formerly denominated *cholemia*, or sometimes *cholesteremia*. Its cause is uncertain, but probably most cases are due to a "terminal infection."

It is possible to differentiate the icterus from gall-stone occlusion from that due to a tumor or resulting from a parenchymatous affection of the liver. In case of gall-stones obstructing the common bile-duct, the jaundice commences suddenly, with pain, after colics with and without icterus. The patient shows signs of cholangitis and seems very sick, with sometimes a general septic condition. In cases of long standing the liver is enlarged, with a tendency to cirrhosis; in the early stages only the right lobe is enlarged. The gall-bladder cannot be palpated, but the region is tender and also the epigastrium. The stools are sometimes with and sometimes without admixture of bile; the urine contains much bilirubin, but no urobilin, and the blood is approximately normal. In case of occlusion of the common bile-duct by a malignant tumor the jaundice comes on gradually and without pain, but with increasing cachexia. The liver is enlarged throughout. The gall-bladder is palpable and distended. Ascites is also observed, and the stools are constantly clay colored. There is also a tendency to hemorrhage and a low hemoglobin percentage. Functional icterus from a parenchymatous affection of the liver comes on slowly, with remissions sometimes for years; pains at times, but no actual colics

Syphilis or chronic intoxications will be discovered in the anamnesis. The liver and spleen are both enlarged, but there is no tenderness in the gall-bladder region and the gall-bladder cannot be palpated. Urobilin is found in the urine, but no bilirubin. The stools are of normal aspect. The blood is sometimes much altered, with poikilocytosis and tardy coagulation. Arnsperger (*Jour. Amer. Med. Assoc.*, from *Beiträge z. klin. Chir.*, Bd. lii, Nu. 1, 1907).

In many patients jaundiced from gall-stone disease the clotting time is normal, and there is no inclination to hemorrhage. In very grave cases of jaundice in which there is a tendency to hemorrhage the ability of the blood to clot is very much lowered. This is independent of the intensity of the jaundice. When in patients with jaundice, who come for operation, an examination shows a retarded clotting time of the blood, we may assume the existence of an advanced stage of a liver affection, which renders the case no longer suitable for operation. Kunika (*Deut. Zeit. f. Chir.*, cxviii, S. 574, 1912).

Etiology.—The duration of obstructive jaundice depends upon the nature of the cause. A simple catarrhal jaundice may last but a few days, while chronic cases may continue many months, though frequently characterized by periods of improvement.

The following significant points must be noted in the diagnosis of chronic catarrhal icterus: 1. Icterus, preceded by hepatic congestion, and by copious biliary diarrhea. 2. Colorless feces of long duration, but with occasional recurrence of the normal color. 3. Diminished secretion of urine, the quantity becoming normal during the periods of improvement. 4. Diminished urea, with normal amount during the periods of amelioration. 5. Diminished quantity of biliary pigment, but toward the end of the disease the urine becomes red in color rather than green. 6. Con-

stant glycosuria after the fifteenth day of the disease. 7. Intermittent elimination of methyl blue. 8. Purpuric spots after the second month, temperature between 38° and 40° C. (100.4° and 104° F.), and a general adynamic, typhoid condition. Audibert (*Revue de méd.*, June 10, 1907).

Case of chronic jaundice caused by tuberculous peritonitis which persisted 15 months. The symptoms caused the authors to hesitate between cancer and lithiasis. An operation showed neither, but demonstrated the presence of extensive peritoneal adhesions with contraction almost to the point of obliteration of the bile ducts. Careful study of the case convinced them that this was due to an old tuberculous peritonitis, in which the inflammatory process had involved the bile ducts. Mouisset and Gaté (*Lyon méd.*, Mar. 2, 1913).

Jaundice as a symptom is difficult to trace to its cause. In approximately 50 per cent. of the cases seen, the absorption of bile was due to obstruction of the common duct by gall-stones; in 20 per cent. of all cases it was due to absorption of bile in the liver, or infective or catarrhal jaundice without duct obstruction. From 5 to 8 per cent. were due to serious infection of the gall-bladder, possibly gangrene with or without stones. These were usually accompanied by a degree of pancreatitis with marked swelling of the lymph glands on the 3 ducts, all persons having 1 on each duct, but no one more than 2. Jaundice from cancer represented but 15 per cent. of the cases; one-half of them were from cancer of the liver, the other half from cancer of the pancreas or of the gall-bladder and ducts. C. H. Mayo (*N. Y. Med. Jour.*, Mar. 13, 1920).

Treatment.—The cause of the jaundice must be determined at the earliest possible moment and the treatment be based on the conclusion arrived at. As emphasized by Cammidge, a diagnosis

of gall-stones obstructing the bile-duct, made on the clinical data and confirmed by an examination of the excreta, calls for immediate **operation**, as the only likely spontaneous cure is nature's crude and dangerous remedy of making a fistula by which the stone may escape into the duodenum, or elsewhere.

Catarrhal jaundice frequently clears up spontaneously, but if after six weeks of **rest in bed**, with **dieting** and **medical treatment**, the jaundice persists and the urinary "pancreatic" reaction is positive, it is advisable to invoke the aid of the surgeon to perform a **short-circuiting operation** to avoid further damage to the pancreas. In the last stages of malignant disease **operation** is only likely to shorten the brief span of life still left to the patient, but in the earlier stages much may be done to make existence more bearable by a **cholecystotomy** or **cholecystenterostomy** to relieve the intolerable itching of which complaint is chiefly made. At the same time it is well to bear in mind that in many cases diagnosed clinically as inoperable carcinoma of the pancreas, it has been shown on chemical examination of the urine and feces, and by the after-history, that the patients were suffering from chronic inflammation of the gland capable of retrogression.

The following causes of chronic jaundice must be taken into consideration: (1) Common duct cholelithiasis; (2) chronic pancreatitis; (3) simple stricture of the common bile-duct; (4) inflammatory adhesions causing pressure on, or stenosis of, the hepatic or of the common bile-duct; (5) hydatid disease of the liver pressing on, or discharging into, the bile-ducts; (6) gummata implicating the duct; (7) chronic catarrh of the bile-ducts; (8) cancer of the common bile-duct; (9) cancer of the head

of the pancreas; (10) cancer of the liver associated with jaundice due either to catarrh or to pressure; (11) cirrhosis of the liver; (12) other rare causes, such as aneurism of the hepatic artery or of the aorta, and other tumors of the liver, gall-bladder, pylorus, or kidney, pressing on or occluding the common bile-duct.

Surgery holds out a good prospect of cure in the first five causes enumerated; **medical treatment** alone is advisable for causes 6 and 7, and in the remainder with certain exceptions relief can be hoped for only from medical or **surgical treatment**. As in many other conditions, pain is the most valuable guide in establishing a differential diagnosis between those possible causes. A painless onset of chronic jaundice points to chronic catarrh, due either to cancer of the liver or of the head of the pancreas, or both. On the other hand, pain in the upper abdomen, followed within twenty-four or thirty-six hours by jaundice, strongly suggests cholelithiasis. Here the jaundice is less intense and is pretty certain to be accompanied sooner or later by intermittent fever, chills, and sweats, with very marked icteric fluctuations. Ascites is very suggestive of malignant disease; it points to it perhaps more strongly than any other single symptom. Other diagnostic anteoperative aids are as follows: Jaundice in cancer of the bile-ducts and head of the pancreas tends to become absolute; in almost every other condition it is variable. Fat in the feces and glycosuria, with very rapid wasting, are very suggestive of pancreatic trouble. If the anteoperative signs be difficult of true interpretation, those found after the abdomen is opened call for as much or more acumen. Adhesions in the neighborhood of a contracted gall-bladder suggest stones, but this may be induced by a simple pyloric ulcer. If the head of the pancreas be swollen and harder than normal, one should not too hastily pronounce it cancer; it may very probably be a simple chronic pancreatitis, curable

by cholecystotomy. Again the discovery of enlarged glands does not warrant a gloomy prognosis, for discrete nodules are frequent in common duct cholelithiasis and in chronic pancreatitis. If they are fused, however, the outlook is bad. The tumor composed of matted omentum and the viscera adjacent to an inflamed gall-bladder always presents a conundrum which aspiration even may not solve; it should not be pronounced malignant until the liver has been carefully inspected for nodules.

The treatment depends on the diagnosis. 1. If it be doubtful, an **exploratory incision** is indicated if the patient's general condition will permit. 2. If malignant disease be positively diagnosed, operation can, with some few exceptions, do but little good save when all the diseased tissue can be removed. 3. If gall-stones or any of the first five factors be diagnosed, **operation** is decidedly advisable if the patient be at all able to bear it. The two great dangers are hemorrhage and shock—accidents such as are liable to follow any severe abdominal traumatism. A study of the unsuccessful cases will no doubt reduce the mortality even lower than it already is; within the last year it has dropped in **choledochotomy** from 14.5 to 7.4 per cent. The anteoperative treatment of ordinary cases is in no way different from that given for a general laparotomy, but when a hemorrhagic condition is expected **calcium chloride** is fed in heroic doses, as this has been found to aid materially in limiting capillary hemorrhage by increasing the coagulability of the blood. A. W. Mayo Robson (Brit. Med. Jour., Jan. 18, 1902).

Rest for the liver as long as there is jaundice is extremely important, especially when there is fever. Hoppe-Seyler (Deut. med. Woch., Nov. 30, 1911).

All cases of chronic obstructive jaundice suggest operative consideration. The relief from itching, besides the prolongation of life, strongly

favours operation, which also obviates pressure-pain from distention of the biliary apparatus. The operations comprise various forms of **anastomosis** of the gall-bladder, hepatic duct, or common duct with the stomach, duodenum, small intestine, or colon. Erdmann and Heyd (Amér. Jour. Med. Sci., Aug., 1916).

In the hemorrhagic tendency of obstructive jaundice, with special reference to its pre- or post-operative treatment, the writer found **gelatin hypodermatically** the most rapidly and uniformly acting coagulant. Sera and blood proved useless. **Calcium salts** by mouth are effective after 10 to 14 days, and should be given for days preceding operation. Aves (Texas State Jour. of Med., Feb., 1917).

The treatment of catarrhal jaundice *per se* requires measures addressed to the catarrhal state. This is accomplished by inducing watery stools by means of saline aperients such as **citrate of magnesium**, **Rochelle salts**, **Epsom salts**, and **waters**, especially **Saratoga**, or **Apenta**. Free purgation is not necessary, but aperient doses should be taken daily. Mineral waters, those of **Vichy** or **Vals**, for instance, should be used freely to increase the proportion of fluid passing through the intestine and liver. When mild purgation is necessary, **calomel** is to be preferred. Hepatic antisepsis is thought to be aided by the use of **sodium salicylate** in 10-grain (0.66 Gm.) doses, or **hexamethylenamine** in 5-grain (0.33 Gm.) doses four times daily. If the jaundice be due to calculus, the measures recommended under **CHOLELITHIASIS** in the article on **KIDNEYS, DISEASES OF**, are indicated.

Another feature of importance is the use of foods which do not require bile to facilitate digestion and absorption and prevent decomposition, and

which are not likely to irritate the intestinal mucosa. **Fats, oils, and irritating condiments should be avoided and skimmed milk, animal broths, egg albumin, and the free use of water are indicated. Warm bathing** assists elimination, and tends to relieve the pruritus.

The idea that milk is the best diet in catarrhal jaundice is fallacious. Milk is particularly unsuitable in this disease because of the amount of fat it contains. The fat is not absorbed, and is decomposed by bacteria. The decomposition products set up irritation, which tends to prolong the disease. Functional **rest of the stomach and duodenum** is most important, and at the outset is capable of aborting an attack of catarrhal jaundice. This rest should be complete for at least twenty-four hours. Alkaline drinks and water or barley-water suffice, provided the patient is strictly confined to bed. Peptonized gruel, made with finely ground oatmeal; clear soup, and soft-boiled rice and dry toast, consommé thickened with tapioca or sago, thin arrowroot with a little milk, first thoroughly skimmed and peptonized, may be used later. As to drugs, **warm alkaline drinks, mineral waters** or a solution of **sodium bicarbonate** to dissolve out the mucus, **saline purgatives**, to remove intestinal contents and waste products from blood. Severe purging should be avoided. Wells (Indian Med. Gaz., Sept., 1907).

Cold injections of water or normal saline solution recommended, favoring biliary flow by promoting peristalsis. Polain-Cartier (Le Scalpel et Liège méd., Revue de thérap. medico-chir., Oct. 1, 1911).

It is unnecessary to resort to an exclusive milk diet in this affection, as has been until lately so often recommended, but in combination to 1 liter (quart) of milk or skimmed milk per diem various vegetable articles of food, *e.g.*, purées of dried vegetables or potatoes, pastes,

such as macaroni, well-cooked green vegetables, or cooked fruits, may generally be permitted. Constipation, if present, should be overcome and an attempt made to free the biliary passages by administering every morning and evening an **enema of 1 liter of cold, previously boiled, water** (15° C.), which should be retained from ten to fifteen minutes; if the chill of the cold water should bring on colic, warm water should be substituted.

The writer prefers not to give calomel, but advises the following:—

℞ *Sodium salicylate*,
Sodium benzoate .of each gr. v (0.3 Gm.).
Powdered rhubarb gr. iiss (0.15 Gm.).
M. et ft. pulvis.

Three cachets, each containing these ingredients in the amounts given, should be taken by the patient daily, before meals. Cachets or pills of **oxgall** may be employed instead. **Hexamethylenamine** should be administered without fail in 4 cachets of 0.5 Gm. (7½ grains) each per diem.

Meteorism may be counteracted by giving, after each of the two heavier meals of the day, a cachet containing:—

℞ *Charcoal*,
Bismuth sub-salicylate,
of each gr. vj (0.4 Gm.).
Powdered nuxvomica gr. ⅓ (0.02 Gm.).
M. et ft. pulvis.

Itching of the skin, often the most distressing symptom of all, requires the taking of a daily **alkaline bath** of ten minutes' duration, in water containing from 100 to 150 Gm. (3½ to 5 ounces) of **sodium bicarbonate**, at a temperature of 35° C. (95° F.). The bath should be followed by application of a **hot lotion of coal tar** (2 tablespoonfuls to the liter), of **vinegar** to which **phenol** has been added, or of 2 per cent. **chloral hydrate**. After the lotion, the follow-

ing inert powder should be dusted over the skin, without previous drying:—

℞ *Bismuth subcarbonate*,

Zinc oxide,

of each 3v (20 Gm.).

Powdered starch. ʒii¼ (68 Gm.).

M. et ft. pulvis.

If the itching continues notwithstanding, a mixture of 1 part of **chloroform** with 3 parts of **glycerin** may be painted over the skin two or three times daily. Finally, baths of **static electricity** with effluve may be administered; these often relieve itching of hepatic origin more promptly than any other measure. Oppenheim (N. Y. Med. Jour., from Progrès méd., Jan. 13, 1912).

The treatment of catarrhal jaundice consists first in hygiene and diet, the patient being put to bed and on a milk diet. Intestinal poisoning is thus combated. About 3 quarts of skim milk daily are prescribed, but **kefir** or **yoghurt** may be substituted. Ordinary diet should be resumed very gradually, eggs being cautiously added and only the white meats used at first. Grapes are thought to be a powerful hepatic stimulant, and lemon juice has its partisans. **Plenty of water** is given to help diuresis; this is important, and mild **mineral waters** may be used. **Cold enemata**, twice a day, are advised. **Benzonaphthol** and **salacetol** are given to combat the intestinal sepsis; a **calomel** purge follows at the end of the first week, then **opotherapy** by means of half a dozen daily capsules of **bile**. Pills of **extract of liver** are sometimes substituted. At the end of the third or fourth week, **hexamethylenamine** and **sodium salicylate** are indicated. If the liver remains enlarged the patient is ordered to one of the **mineral spring resorts**, or a powder may be given of **sodium bicarbonate**, 8 Gm. (2 drams); **sodium phosphate**, 4 Gm. (1 dram); **dried sodium sulphate**, 2 Gm. (½ dram), dissolved in a quart of hot

water and taken three times daily one hour before meals. Jaundice is often a sign of infection. If it persists, repeated **calomel** purges are given, the **bile opotherapy** is continued; also the **cold enemata**.

Itchiness of the skin is best combated by very hot lotions containing **alcohol** or **vinegar** or dilute **carbolic acid**, or by **zinc oxide ointment** containing a small proportion of **menthol**. Hemorrhage is met with **calcium chloride** and **opotherapy**. Lereboullet (Paris méd., Sept. 14, 1912).

For the treatment of itching of jaundice the following lotion is recommended:—

℞ *Resorcinolis*,

Mentholis .. āā gr. xv (1 Gm.).

Hydrargyri

chloridi cor-

rosici gr. iij (0.2 Gm.).

Glycerini f5v (20 c.c.).

Aque colognien-

sis f3iij (100 c.c.).

Alcoholis f3xiij (400 c.c.).

M. et ft. solutio.

Sig.: To be used as a wash.

L. Aldor (Nouveaux remèdes, Jan. 24, 1913).

TOXEMIC JAUNDICE (HEMOLYTIC JAUNDICE; HEMATOGENOUS JAUNDICE; HEMOHEPATOGENOUS JAUNDICE; JAUNDICE OF POLYCHROMA; NON-OBSTRUCTIVE JAUNDICE).—In this form there is said to be no obstruction in the bile passages. This in most, if not all, cases is not correct, because, although the larger ducts are free, the bile radicles within and around the hepatic lobules are obstructed to a greater or less extent by swelled epithelium, pigment granules, and crystals of leucin and tyrosin. The obstruction in these cases is shifted from the larger ducts to the bile radicles, many of which escape, so that the obstruction is rarely complete. The cause acts on

the liver substance in general and must, therefore, be toxic and conveyed to it by the blood, either of the general or the portal circulation. The toxin acts on the blood, and in its excretion by the liver leads to the secretion of a viscid bile, to irritation of the bile radicles, and it may be to degenerative changes in the liver cells.

Hunter recognized three groups of this class of cases:—

1. Jaundice due to poisons, as toluylendiamin, phosphorus, arseniuretted hydrogen, picric acid, and snake-venom. This type includes post-operative jaundice, due to the toxic action of the anesthetic, chloroform especially, and those following injections of salvarsan.

Case of a man aged 32 years in whom a first injection of 0.5 Gm. ($7\frac{1}{2}$ grains) of salvarsan was followed by severe headache, backache, vomiting, diarrhea, and motor weakness, all of which had disappeared by the next day. A second injection of 0.6 Gm. (10 grains), given six days after the first, at first seemed well borne; but on the following day there appeared similar symptoms, together with fever and pains throughout the body. Twenty-four hours later signs of oncoming jaundice were observed, and eight days after the second injection marked icteric hue had appeared. Treatment proved utterly unavailing, the jaundice persisting eight months. The stools were white, the urine discolored. The body weight fell rapidly from 80 to 58 kg. (176 to 127 pounds) and the hemoglobin to 60 per cent. E. Giradet (*Revue méd. de la Suisse Romande*, Dec., 1913).

Many cases of jaundice among munition workers, due to trinitrotoluol, were reported during the European war. Tetrachlorethane has also at times caused jaundice. The skin is believed the main channel of absorption of these poisons. Ac-

cording to M. J. Stewart (*Brit. Med. Jour.*, Feb. 3, 1917) the associated liver lesion lies somewhere between subacute yellow atrophy and ordinary multilobular cirrhosis of irregular distribution. Dermatitis, gastritis, and blood changes typically accompany the toxic jaundice. W. J. O'Donovan (*ibid.*) states that the jaundice may supervene from the fourth day to the ninth month of munition work, and may first appear after a period of freedom from exposure extending as long as 2 months. The prognosis is uncertain, coma or convulsions suddenly setting in sometimes when recovery was expected. According to W. R. Smith (*ibid.*) constipation is an almost invariable symptom. **Absolute rest in bed** is essential even in the mildest cases, and where there is a tendency to hemorrhage **calcium chloride** may be used. EDITORS.

2. Jaundice occurring in various specific fevers, as yellow fever, malaria, pyemia, typhoid, typhus, and scarlatina.

In a man of 46 who died after three weeks of an infectious jaundice a paratyphoid bacillus was cultivated from the blood during life and from the liver, spleen, etc., *post mortem*. It is probable that many cases of so-called catarrhal icterus are in reality a general infection with secondary localization in the biliary apparatus. O. Scheel (*Norsk Mag. f. Lægevidenskaben*, Jan., 1910).

The writer was able to cultivate the pneumococcus from the blood in 3 cases of pneumonia complicated with jaundice. Autopsy revealed inflammation in the parenchyma of the liver; the inflammation in the vessels and ducts was secondary. Lemierre (*Presse méd.*, Feb. 2, 1910).

3. Jaundice occurring in obscure infective conditions, as in epidemic, infectious, febrile, or malignant jaundice, icterus gravis, Weil's disease, and acute yellow atrophy of the liver. To this group probably belongs, in the light of modern work, the jaundice due to syphilis.

Case of fatal icterus due to secondary syphilis. Icterus appeared insidiously without apparent cause. The patient, a young woman, presented the stigmata of secondary syphilis, the absence of pre-existent digestive troubles, the absence of fever, and later the presence of a subnormal temperature, the absence of bradycardia, the nocturnal malaise which disappeared during the day, and finally the sudden development of this seemingly benign icterus into a malignant form. Sezary (*Presse méd.*, Sept. 26, 1908).

Syphilitic jaundice which occurs in the secondary stage is not a mere symptom of catarrhal character, but a manifestation of precocious syphilitic lesions. The diagnosis is made from the history and from the presumptive evidence of the test of treatment. The jaundice usually comes on without any preceding gastric or intestinal disturbances, but there may be slight pain over the liver and a moderate degree of hypertrophy of this organ. The spleen is enlarged and the jaundice does not yield to any other treatment save the **anti-syphilitic**. Fonoglietto (*Riforma Medica*, Nov. 22, 1909).

Case of icterus syphiliticus. The exanthem retrograded under **mercury salicylate**. After the sixth injection the patient began to suffer from slight catarrhal symptoms of the intestine with some swelling of the liver. The course was favorable; there was absence of general, particularly cerebral, symptoms, and the absence of diminution in the size of the liver marked the affection clinically as a simple, perhaps somewhat intense, icterus syphiliticus *præcox*. After about two weeks leucin and tyrosin were found in the urine, which are usually met with in syphilis only in yellow atrophy of the liver. This raised the question whether, instead of a benign icterus, the case was not one of parenchymatous inflammation of the liver that would result in yellow atrophy, and whether the syphilis was the cause of the

affection. Busche (*Berl. klin. Woch.*, Feb. 7, 1910).

The writer found leucin and tyrosin in the urine in a case of mild jaundice in the early phase of syphilis. This finding is characteristic of acute yellow atrophy of the liver, but the mild course of the jaundice in this case shows that a parenchymatous inflammation of the liver may occur and retrogress without leaving serious traces. It is possible, however, that the liver may prove less resistant thereafter. All of the writer's patients with syphilitic jaundice in the last two years had been examined for tyrosin and leucin, but this, with 2 infants with inherited syphilis, were the only ones in which the reactions were obtained. Bruns (*Berl. klin. Woch.*, Feb. 7, 1910).

In this class the jaundice is usually less intense than in obstructive jaundice. There is only a partial absorption of the bile pigment by the lymphatics of the liver. Bile appears in the stools at some period of the history; it may be in excess, causing very dark fecal discharges. It is thus distinguished from true obstructive jaundice in that the stools are not clay colored.

There is usually more constitutional disturbance than in obstructive jaundice. In severe cases this is very pronounced—high fever, dry tongue, delirium, subsultus, convulsions, hemorrhages from various parts, black vomit, all indicating severe constitutional infection.

In an epidemic of jaundice studied by the writers, several features asserted themselves: (1) The infectious character of the disease was clear. The sudden onset with chill, fever, headache, general muscular pains, and leucocytosis are evidence of infection and intoxication. The negative results of blood-cultures point to some local infection rather than to a bacteremia. (2) The gas-

gastrointestinal features, nausea, vomiting, diarrhea, and colicky abdominal pain, make the diagnosis of gastroenteritis necessary, and this is in accord with the opinion that food, and probably meat, was the most likely source of the infectious agent. (3) In every case the jaundice was obstructive in type, lasted only from two to three weeks, and exhibited the characteristics of catarrhal jaundice associated with gastroenteritis. A bacterial invasion of the bile passages and even the liver is possible. The finding of tyrosin in the urine of 2 cases is in favor of this. (4) Either water or food (the only things in common in these cases) must have been the source of the infection. The only positive results of the bacteriological study in the cases suggested the *Bacillus paratyphosus* as the invading micro-organism. Two possibilities present themselves. Either it may be assumed that the bacillus already present in the intestinal tract of several prisoners rapidly multiplied during a period of lowered resistance from unknown cause, or the bacillus was introduced through the food. The sequence of events in these cases was as follows: Ingestion of tainted meat, containing living paratyphoid bacilli; development of a gastroenteritis due to this micro-organism, and the appearance of a catarrhal jaundice due to extension of the gastroenteritis to the biliary passages. Barker and Sladen (Bull. Johns Hopkins Hosp., Oct., 1909).

Of 12 cases of infectious jaundice reported by the writer, 11 occurred in the same locality. In one family 3 sisters were affected in three weeks. A school teacher had jaundice on February 10th, and in about fourteen days was quite well. A girl came to live in the house early in March, and in a few days she developed a severe attack of jaundice. Hallowes (Brit. Med. Jour., June 24, 1911).

Four cases of jaundice occurring consecutively in the children of one family within a period of less than four weeks. About the same time,

at least in one family living only two blocks from the other, all 8 children became affected by jaundice. Contact among the children of the two families was very improbable. Three of the 4 cases observed by him were quite mild.

The disease occurred in November and early December, when the weather was cool and damp, and it is a notable and well-established fact that autumn and winter are the most common seasons of epidemic icterus; not the summer, as the greater prevalence of acute and chronic gastrointestinal disturbances would lead us to expect. A. Strauch (Med. Rec., Apr. 18, 1914).

All cases usually show: (1) Destructive changes in the blood; (2) alterations in the quantity and quality of the bile; (3) changes in the liver cells and bile-ducts, varying in degree according to the irritant power of the toxin.

Hemolytic jaundice may be congenital, displaying hereditary and familial tendency, in which case it is absolutely typical, or the condition may be acquired from various influences; the resulting affection then differs widely in different individuals. Both forms, however, show a bright yellow jaundice, quite different from the general dull tint of icterus from cirrhosis. The icterus also varies in intensity from time to time, emotions and fatigue accentuating it, while it subsides during rest and in mountain air. Another striking feature is the absence of all signs of biliary intoxication. The stools are not clay colored, and bilirubin is only in small proportions in the urine. The spleen is generally enlarged. Examination of the blood shows anemia with extremely fragile red corpuscles, large numbers of granulated reds and occasionally autoagglutinating properties. Examination of the blood will reveal the hemolytic origin of the jaundice, and under iron the condition may be improved. Widal, Alvami, and Brulé

(Arch. des mal. du cœur, etc., April, 1908).

Blood-pigments may be changed to biliary pigments without the aid of the liver. The endothelial cells of the vascular system, bone-marrow, and muscular apparatus probably take part in this process. Apparently, no exact histological examinations have been made. The writer's researches have suggested that endothelial cells rank first in consideration as a cause of hematogenous icterus. McNec (Med. Klinik, July 13, 1913).

The writer's evidence on congenital hemolytic jaundice points conclusively to an inherited taint, syphilis or tuberculosis, on which is superposed some abnormal hemolytic action on the part of the spleen, as the factors responsible for the hemolytic icterus. Chauffard (Annales de méd., Jan., 1914).

The abnormal fragility of the red corpuscles is shown by adding a drop of the blood to each of 6 test-tubes containing from 60 to 70 drops of a 7 to 9 per thousand salt solution with enough drops of distilled water added to bring each to 70 drops. Each tube is centrifuged and the fluid turns pink or red proportionally to the resisting power of the reds. The serum does not seem to contain free hemolysins, but the spleen is very large and at times is painful. One patient developed a pigmented retinitis, showing that the excess of pigment is not always an indifferent matter. Roch (Revue méd. de la Suisse Romande, Mar. 20, 1914).

Hemolytic jaundice is characterized by a diminution of globular resistance. There is also a reduction of the average diameter of the red corpuscles and anisocytosis, *i.e.*, inequality and deformation of the corpuscles. In a patient observed by the writer, the average diameter was from 3 to 5 microns. In jaundice by retention, on the contrary, we get increased resistance and diameter, so that there is absolute opposition between the two types.

Hemolytic jaundice is also peculiar by reason of the presence of a large number of granular red corpuscles, which must not be looked upon as changed red corpuscles, but in reality as elements of abnormal, atypical, pathological regeneration. The absence of auto-agglutination and of auto-hemolysis completes the hemotological characters of congenital hemolytic icterus. A. Chauffard (Med. Press and Circular; in Can. Pract. and Rev., Sept., 1917).

The writer records 4 personal cases showing icterus, anemia, diminished corpuscular resistance and splenomegaly, with or without enlargement of the liver. The icterus was of the acholuric type and the blood serum contained bilirubin but no urobilin. The feces were acholic and only assumed their normal color during the hemolytic paroxysms. The blood showed the usual changes of secondary anemia, but did not always contain the granular red cells mentioned by Chauffard. The writer noted the presence of isolysins in all cases, while the autolysins were less constant, and found experimentally in dogs that these bodies could cause hemolytic icterus. He concluded that these autolysins probably developed at the time of the paroxysms of anemic icterus and were probably produced in the spleen Lüdke (Münch. med. Woch., Oct. 1, 1918).

The destructive changes in the blood are shown by the occurrence of hemorrhages especially from the mucous surfaces, as of the nose and stomach. The black vomit of yellow fever furnishes a striking example of such hemorrhages. The changes in the bile are characterized by its increased viscosity, great increase in its pigment, and diminution of the bile acids. The parenchymatous changes in the liver are evidence of the action of the toxins on the liver. Similar changes occur in the kidneys. The urine is bile stained and the true

biliary pigments, notably urobilin, are greatly increased.

Five types of disease require differentiation from hemolytic icterus and, of course, from one another. The first is *pernicious anemia*, in a number of cases of which diagnosis has been difficult. Next is mentioned *Gilbert's familial cholemia*, regarded by some as identical with hemolytic icterus. Chalker, a recent writer, regards the former as a mild type of the latter, and points out well-marked dissimilarities. Third comes *Banti's disease*, including its hemolytic form. Fourth in order is *polyglobulia*, both of the compensatory and cyanotic types. Finally is added the Gaucher type of *splenomegaly*, because some of the recorded cases might have been termed hemolytic icterus. Mosse (Berl. klin. Woch., Apr. 14, 1913).

The special feature about hemolytic jaundice is the intensity of the jaundice in contrast to the fine state of the health in general. Roch (Revue méd. de la Suisse Romande, Mar. 20, 1914).

In many varieties the toxins that excite these changes are generated in the intestinal tract, as gastrointestinal symptoms are usually prominent in the initial stage of the illness. In this way we may account for the absence of specific organisms in the liver in acute yellow atrophy, for example. According to Hanot, the form of icterus gravis in which the bacillus coli is found is accompanied by lowering of the temperature, while the other forms of the same disease which are accompanied by fever are characterized by the presence in the liver and blood of pyogenic microbes.

Syphilitic jaundice, according to Werner, is characterized by (1) its appearance in the early secondary stage, (2) the presence of fresh specific manifestations, (3) the in-

fluence of treatment, and (4) its sudden development without gastric disturbance. Long duration is not characteristic of syphilitic jaundice. In typical cases this icterus occurs at a time when syphilis affects the skin and mucous membranes. Hepatic enlargement is not a striking feature in the disease. In 22 out of 50 cases the jaundice was noted within six months after the infection. The syphilis in most of Werner's cases was severe.

In some cases, as in pyemia and snake-venom, the poison finds its way to the liver through the general circulation.

Treatment.—A careful search for the causative toxic, whatever that may be, is the first step. Treatment aiming to **remove the cause**, often syphilis, malaria, and helminths, should then be supplemented by means calculated to **prevent hemolysis** and **stimulate regeneration of the blood**—arsenic, calcium chloride, organotherapy, or cholesterin. The last seems to be proving useful in checking hemolysis in pernicious anemia, hemolytic icterus and hemoglobinuria. It has not been used in a sufficient number of cases for a decisive judgment, but to date the results have been very encouraging. **Splenectomy** has given good results; exposure to the **Röntgen rays** has also been recommended.

Treatment should be directed against the anemia, but bone-marrow and arsenic have not to date displayed any efficacy, while iron has given great benefit in many cases. It does not arrest the hemolytic process; the reds continue to be fragile and to be destroyed, but the processes of repair are stimulated by the iron and the blood soon approximates normal. Everything should be

avoided that leads to excessive destruction of the red corpuscles; the condition improves materially under the influence of **rest** and **nourishing food**. Widal, Abrami, and Brulé (*Arch. des mal. du cœur*, etc., Apr., 1908).

To prevent and overcome post-operative hemorrhage in patients with chronic jaundice, Mass and Gelien report 5 cases of hemorrhage in which the **injection of serum** proved apparently beneficial. Three of these cases were intestinal hemorrhage from typhoid fever. In 1 case **defibrinated human blood** was **injected intravenously**; in the other 2, **fresh rabbit serum**: in 1 case, **intravenously**; in the other, **subcutaneously**. In all 3 cases the hemorrhage ceased soon after the injection. The writer used **human serum**, with Welch's technique as a successful preoperative prophylactic against hemorrhage in 4 cases of chronic jaundice (due to cancer of biliary tract or pancreas) with success. The treatment should be given before and after operation. It should be started at least two days before, and 30 to 60 c.c. (1 to 2 fluidounces) of serum should be injected subcutaneously three times daily. The same should be done for another forty-eight to seventy-two hours after operation. Enough serum should be obtained in time. Both cephalic veins of two healthy individuals should be tapped. This will yield from 300 to 400 c.c. (10 to 13½ fluidounces). Willy Meyer (*Surg., Gynec. and Obstet.*, Aug., 1911).

The fact that congenital hemolytic jaundice was due in the author's series of cases to syphilis or tuberculosis suggests the necessity for specific treatment, with possibly reduction of spleen functioning by **Röntgen exposures** or **splenectomy** as the last resort.

No case of recovery has been known, but treatment along the above lines has never been applied systematically enough to date for any estimation as to the possible thera-

peutic outcome. Chauffard (*Annales de méd.*, Jan., 1914).

Of 12 out of 17 patients on whom **splenectomy** was performed by the writer, 10 are living; 9 are in excellent health without jaundice or anemia. There was 1 operative death. One patient died 4 months after operation; another patient with a severe form of the acquired type of the disease was in excellent health for 18 months, had a relapse after 2 years, and is again in fairly good health after 2½ years following two transfusions. Four patients have been in excellent health for 14 months, 15 months, 23 months, and 5½ years respectively. Griffin (*Surg., Gynec. and Obstet.*, Aug., 1917).

In a personal case, the patient and a brother had both had hemolytic jaundice since childhood and the spleen was extremely large. On exposure of the spleen to the X-rays, pains developed in the region, but after **splenectomy**, both the pains and the jaundice disappeared in 2 days. In 2 other cases the erythrocytes numbered only 1,200,000 and 1,870,000, but the blood picture rapidly improved after splenectomy. Hartmann (*Bull. de l'Acad. de Méd.*, Paris, July 29, 1920).

ICTERUS NEONATORUM (See NEWBORN, DISEASES OF.

ACUTE INFECTIOUS JAUNDICE (Weil's Disease).—In 1886 Weil described "A peculiar form of acute infectious disease characterized by jaundice, swelling of the spleen, and nephritis." This has been recognized by German writers as a new disease. But others have looked upon it only as what has long been described as "acute infectious jaundice," a name that serves sufficiently to designate it.

Spirochetosis Icterohemorrhagiæ.—During the war many cases of infectious jaundice developed in Italy, France, Turkey, etc. It now seems proved that at least one

form of the disease is caused by the *Spirochæta icterohemorrhagiæ*. Hence the above name now frequently given the disease. EDITORS.

Symptoms.—The disease presents the symptoms that characterize acute infections generally. It sets in suddenly, usually with chill, followed by fever, pain in the back and limbs, loss of appetite, thirst, general malaise, headache, giddiness, and usually diarrhea. The symptoms increase for a day or two, the temperature rising rapidly to 104° or 105° F., weakness increases, and there is mild delirium. Jaundice appears on the second or third day, with marked enlargement and tenderness of the liver and swelling of the spleen. The urine becomes albuminous and shows the other signs of acute nephritis. There is marked derangement of the digestion—furred tongue, nausea, and sometimes vomiting. The symptoms begin gradually to subside by the fifth to the eighth day. The persistent high temperature falls, gradually reaching the normal by the tenth or twelfth day. The jaundice abates with the other symptoms.

From the hundreds of cases in the Italian army the writer has had in his care, he describes the disease as follows: There is an incubation of a week or two, then the period of invasion which lasts from 2 to 6 days, with fever usually so slight that it is not noted, but there is no jaundice although there may be intense muscular pains, suggesting rheumatism, or digestive disturbances with headache, suggesting typhoid. Then follows the stage of jaundice, during which the temperature drops to normal or even below and the pains subside. There is usually an interval of a day between defervescence and the onset of the cholemia. It is accom-

panied by weakness, at times extreme. The spleen and liver are enlarged. A special feature of the disease is that the temperature runs up again after an interval of from 4 to 6 days. The glands also swell, especially in the right axilla. There were no hemorrhages from skin or mucosa in his cases, but a tendency to rhinorrhagia was common. As the jaundice and albuminuria subside, the depression is extreme, with vague pains, low blood-pressure and brownish tint of the skin and the prostration and convalescence are long protracted. Bravetta (Policlinico, May 26, 1918).

It is evident, however, judging from cases of infectious jaundice observed in different countries, that several types of the disease must be recognized.

The writer encountered a large number of cases of an epidemic infectious jaundice among the troops at the Dardanelles, differing somewhat from the type commonly seen. The onset was marked by lassitude, anorexia, headache, pain in the upper abdomen, slight enlargement and tenderness of the liver, and fever up to 102° F. for a few days. The symptoms continued for 3 to 5 days after the fever had returned to normal, when jaundice made its appearance with bile stained urine, weakness, rapid pulse, slight albuminuria, and a tendency to cardiac dilatation. Convalescence was slow. All attempts to discover the parasites of Weil's disease failed. C. J. Martin (Brit. Med. Jour., Apr. 7, 1917).

From 200 to 250 cases of infectious jaundice have been known within the last 15 years in Nexø, a seacoast district in Denmark which has a population of less than 6000. Both man and the domestic animals are affected by the disease. Bacteriologic examination has revealed only paratyphoid B bacilli. The disease can be transmitted from man to animals and from animals to man. The jaundice is the first and most striking symptom, with

tenderness of the gall-bladder, but diarrhea, often bloody, accompanied by colic pains mainly around the umbilicus, persisting in spite of all medication for weeks and months, is the most serious feature of the disease, along with the great depression in the general health, the somnolency, anemia and dull, sunken eyes. Bleeding from mouth, nose, bowel and urinary apparatus is common, as also complicating pneumonia and myocarditis. Five of the writers' patients died, and in all there seemed to be a tendency to recurrence. Kamp and Wernoe (*Ugesk. for Læger*, Nov. 1, 1917).

Convalescence is usually uninterrupted, but in a certain number—about one-fourth—the fever recurs within a week, lasting five or six days, in only a few cases being accompanied by recurrence of jaundice, swelling of the liver and spleen, and albuminuria.

Convalescence is always slow, the strength not being restored for many weeks.

Of the symptoms, the most marked usually are the muscular pains, especially in the calves of the legs. The pains may be so severe as to obscure the other symptoms. They are much increased by movement and by pressure of the muscles.

Etiology.—It is met with usually among males between the ages of 15 and 30 years, but has been seen in children as young as 8. It occurs usually in endemic outbreaks in summer, affecting chiefly workmen engaged in insanitary occupations or environments. It is rare in America. It doubtless belongs to the group of toxemic jaundice but as to the nature of the infection, whether specific or multiple, it is still to be determined. In 2 of 3 fatal cases Jaeger found a bacillus of definite characters in the organs of the body, and in the urine of 4 out of 6 cases

that recovered, the same organism was found. Ducks and geese—frequenting the river in which these patients were supposed to have acquired the disease by bathing—were subject to a fatal form of jaundice, and in them similar post-mortem changes and the same organism were found. During the war, the disease seemed to be communicated by field rats which infested the trenches, and also abrasions.

Morbid Anatomy.—The liver changes resemble those found in acute yellow atrophy, but to a much less degree. There are fatty degeneration and cloudy swelling of the renal epithelium, or even an acute parenchymatous nephritis. Minute hemorrhages exist in various organs and on the serous surfaces. The spleen is swelled. There are no traces of typhoid ulceration. Where the spirochete caused the disease, it was usually found in the urine.

In 276 cases of spirochete jaundice observed in troops, the writer found the gall-bladder always enlarged and tender and the liver usually much enlarged from the very first. The spirochetes seem to be found constantly in the urine, and hence the close quarters in the trenches favor transmission of the infection in food and water. The spirochetes may also find their way into the body through abrasions. Salvaneschi (*Riforma Medica*, February 16, 1918).

Prognosis.—Only a small number of cases have terminated fatally, but convalescence is protracted.

Treatment.—This is quite symptomatic. The pains will require **anodyne** for their relief.

In 14 cases of infectious jaundice the treatment adopted in most cases was **calomel** or **mercury with chalk**, **salines**, and, if necessary, **enemata**, and then **salicylates**, and liquid ex-

tract of **cascara** until the jaundice disappeared. At the time the writer regarded the cases as influenza of the gastrointestinal type with this peculiarity, that the part of the intestinal tract principally affected was the duodenum. Whitaker (*Brit. Med. Jour.*, Oct. 14, 1911).

In many cases of acute infectious jaundice in children it is only necessary to **restrict fats** and to give soup, lean meat, vegetables, skimmed milk and bread. C. Herrman (*Med. Rec.*, Aug. 30, 1913).

In a series of 300 cases of spirochete jaundice, the writer found a combination of **arsenic** and **mercury** very useful in treatment. Carpi (*Polí-clinico*, July 29, 1917).

ACUTE YELLOW ATROPHY OF THE LIVER (MALIGNANT JAUNDICE; Acute Parenchymatous Hepatitis).—**Definition.**—A grave form of jaundice characterized by extensive destruction of the liver cells, with atrophy of the liver and clinically by grave constitutional disturbance in which the cerebral symptoms are especially prominent.

Symptoms.—In the prodromal period there is no time to distinguish it from ordinary jaundice. The same symptoms usher in loss of appetite, malaise, nausea, and vomiting, jaundice following in a day or two. It differs from ordinary jaundice in the occurrence of some rise of temperature.

This stage may last from a few days to two or three weeks. The bowels are constipated and feces pale; the urine contains bile pigment. There may be pain in the hepatic region.

Suddenly a marked change occurs, characterized by severe headache, repeated vomiting, delirium, and restlessness. The vomited matters are at first bile stained and later contain blood more or less altered, and the stools may

also contain blood making them dark and offensive. At the same time the jaundice deepens and becomes of a greenish hue. The temperature falls to normal, or usually below it; the pulse rises to 120 or more and becomes weak. Stupor sets in and deepens into coma. There may be convulsions. In women menorrhagia may occur and, if pregnant, abortion or premature delivery takes place.

In the early stages there are no characteristic symptoms that differ from ordinary catarrhal jaundice. Nervous symptoms should put us on our guard and lead to a careful examination of the urine for the presence of leucin and tyrosin. As the case develops, the jaundice becomes more pronounced, vomiting persists, with possibly hematemesis or the appearance of purpura. Headache, noisy delirium, restlessness, followed by coma and possibly convulsions, quickly lead to a fatal termination. In the early stage the liver is slightly enlarged and tender. Death may occur before the liver diminishes in size. Huber (*Arch. of Pediat.*, Oct., 1912).

The urine becomes deeply bile stained and often contains tube casts. It becomes lessened and may be suppressed. There is great diminution, or even absence, of urea, and its place usually is taken by abnormal constituents, especially by tyrosin and leucin.

The most characteristic physical sign in this stage is the rapid diminution, it may be disappearance, of the area of hepatic dullness; so that the hepatic area may become tympanitic. It is also frequently tender to pressure, even in the comatose state.

The stage lasts only two or three days and nearly always terminates fatally.

Diagnosis.—It is not possible to distinguish acute yellow atrophy before

the development of the grave symptoms. Then the symptom group is characteristic: intense jaundice; severe, persistent vomiting; rapid disappearance of hepatic dullness; delirium, passing rapidly into coma; leucin and tyrosin crystals in the urine.

Hypertrophic cirrhosis sometimes presents similar symptoms, but the long duration and the large liver serve to exclude this affection. In this the symptoms of icterus gravis may develop and the case present all the features of acute yellow atrophy.

Phosphorus poisoning closely resembles acute yellow atrophy, but the liver does not diminish so rapidly, if at all, the nervous symptoms are not so grave, leucin and tyrosin do not usually appear in the urine in phosphorus poisoning, and the gastric symptoms are usually more severe.

Etiology.—This disease is rare. A few observers have, however, seen several cases within a few months, indicating an endemic agent, while others with large experience have not met a case.

No age is exempt, from the infant of a few days to the octogenarian. It is most common between the ages of 20 and 30 years.

It is more common in females than males, especially between the ages of 20 and 40; that is, during the child-bearing period. Pregnancy has a most important bearing on the causation, nearly half the cases met with in women occurring during pregnancy, especially the latter part of it. This is probably explained by the fact that some degeneration of the cells of the liver and kidney is a common condition in pregnancy. Fear and mental emotion have apparently been the cause in a few cases,

Acute yellow atrophy of the liver during pregnancy is quite rare. From 1883 up to the present time, 37,475 labors and abortions were treated at the Government Maternity Hospital in Madras, and during that period but 5 cases of this disease have been noted. In 1886 2 cases were recorded. The writer gave, in a case reported, thyroid extract on the supposition that the disease was one due to perverted metabolism, but, of course, no results could be obtained, as the patient rapidly succumbed. A. J. Sturmer (Brit. Jour. of Obstet., Dec., 1903).

Alcoholic excess has preceded the disease in several cases. The disease may be the result of various infections, such as typhoid, diphtheria, and septicemia. The resemblances of the symptoms to those of phosphorus poisoning are undoubted, but there are essential differences in the resulting morbid changes that render it clear that the two conditions are not identical. In view of the variety of conditions under which the disease occurs, it is highly probable that it is due to various forms of infection.

Case of acute yellow atrophy of the liver in a previously healthy man five months after infection with apparently mild syphilis. The liver infection proved fatal in ten days. In this and 3 other cases recently reported, search for spirochetes in the liver was unsuccessful. The affection is probably of toxic origin. Acute yellow atrophy of the liver in connection with syphilis has been observed in about 50 recorded cases. W. Fischer (Berl. klin. Woch., May 11, 1908).

Morbid Anatomy.—The liver is greatly reduced in size; it may be less than half its normal weight. It is thin, flabby, and wrinkled in appearance.

On section it is tough rather than firm. The cut surface varies in color

from a yellowish to a reddish brown and is often mottled irregularly. The lobules are small and indistinct; in the parts most advanced in degeneration they cannot be distinguished.

On microscopical examination the liver cells are found greatly degenerated, containing swelled, indistinct nuclei and fat granules. In many parts they have been entirely replaced by fat granules and *débris* held together by the liver stroma.

In less degenerated parts the periphery of the lobules is most affected where the cells are disintegrated and the biliary canaliculi distended with desquamated epithelium and granular masses of bile pigment, constituting a complete obstruction to the flow of bile. In these parts active cell division may be found, as if an effort were being made to regenerate the hepatic parenchyma. It is possibly due to this activity that recovery takes place in rare cases.

In acute yellow atrophy, the poison, whatever its nature may be, may affect the liver very unequally and in different degree. The poison may also act only locally, and recovery take place. Stroebe (Ziegler's *Beit-räge*, vol. xvii, p. 206).

The larger bile-ducts are usually free from bile, containing mucus only; the gall-bladder often contains a little bile.

Micro-organisms of various kinds have been found in some cases, but not with such constancy as to indicate that they have taken any active part in the causation of the disease.

Prof. A. B. Macallum, from a study of a case of mine, and others concluded that the disease was caused by a toxic agent carried to the liver by the portal vein and, therefore, originating in the intestine.

There is general bile staining of other organs and tissues. Numerous hemorrhages are found in various situations. The heart, voluntary muscles, and renal epithelium usually show fatty degeneration. The spleen is large and there may be considerable effusion into the pleural and pericardial cavities. There are evidences of catarrh in the digestive tract.

In acute yellow atrophy the cord may show changes which seem to be, like atrophy of the liver, the result of the severe general intoxication (Goldscheider and Moxter).

Prognosis.—The disease is so fatal that recovery almost implies a mistake in diagnosis. Yet Martinez states that the statistics of the Havana Civil Hospital show that acute yellow atrophy is by no means necessarily fatal. Weising, in 1892, in reporting a favorable case, stated that it was the sixteenth on record at the time.

Treatment.—This is purely symptomatic. There are no remedies known to have any influence on the disease. On the plea that the hepatic lesions are due to autolysis, Sajous advocates **saline solution**, used freely by the mouth, rectum, hypodermically, or intravenously, as soon as the nature of the disease is recognized. The rectal injection of **peptone, eggs, and milk** to nourish the patient, while avoiding the hepatic circuit, was a feature of Weising's successful case. The **ice bag** over the liver affords relief.

In a case of acute yellow atrophy sole dependence was placed on hypodermic **sodium bicarbonate injections**. One week after admission to the hospital the patient began to improve, the liver dullness rapidly receding, and was well in 1 month. C. P. Longridge (Jour. Royal Army Med. Corps; Med. Rec., Oct. 7, 1916).

ABSCESS OF THE LIVER (Suppurative Hepatitis).—Symptoms.

The outset of the disease is always insidious and the course may be latent throughout, an unsuspected abscess being found at the autopsy. When not latent, the cardinal symptoms are: fever, with free perspiration, pain, enlargement of the liver, and signs of septic infection. There are loss of appetite, more or less rapid emaciation and increasing weakness and anemia. There is a sense of weight and distress in the epigastric and right hypochondriac regions, with sometimes hiccough, nausea, and even vomiting. An icteroid hue develops; rarely, marked jaundice. The temperature is elevated from the first and is of a septic character. It is irregular, being normal at times, then rising to 103° F. or more, with a more or less marked chill, to defervesce again with profuse sweating. These variations may be so regular as to clearly simulate malarial fever, but the variations lose their regularity in a few days. In other cases typhoid fever is simulated. With the evacuation of the pus, the temperature may fall to normal and remain so; much will depend on the thickness of the abscess wall and whether other foci of suppuration coexist. The pulse rate varies in general with the temperature, but toward the end of life it becomes greatly accelerated and feeble.

Pain is variable, and probably is not present until the abscess approaches the surface of the liver. It is usually referred to the scapular region, but may be felt in the region of the liver. The patient usually finds lying on the back or right side most comfortable; on the left side the liver drags on its liga-

ments and any inflammatory adhesions that may be formed and causes discomfort. Pressure at the costal margin, especially in the nipple line, is usually painful.

Enlargement of the liver is most marked in the right lobe, and may be more apparent in the erect posture. In multiple abscesses and pylephlebitis the enlargement is general and rarely great. In tropical abscess when situated, as it usually is, in the dome of the liver, the enlargement is chiefly upward, contrasting with the downward enlargement usual in new growths of the liver. The area of thoracic dullness may be sharply convex upward and rise to the fifth rib in the midaxillary line and posteriorly to the angle of the scapula. It has been reported to even reach the second rib in front and the spine of the scapula behind. In these cases of extremely large abscess the right side is bulged and the lower margin of the liver depressed, it may be, to the iliac crest; over the liver there is tenderness and often crepitus on palpation; and occasionally fluctuation may be elicited.

The classic symptoms of abscess of the liver are very often lacking and therefore not to be relied upon. The important factors leading to diagnosis are inflammation of the pleura with possible effusion, and a spot very painful on pressure, when these accompany the classic symptoms. The writer does not attach much importance to the X-rays or blood and urine examinations. He warns against the abuse and supposed harmlessness of the exploratory needle, and insists that the diagnosis should be made on the clinical data. Giordano (*Riforma Medica*, May 25, 1912).

Owing to the frequent situation of the abscess in the dome of the liver, implication of the lung is more frequent

in the tropical, or amebic, cases than in the septic ones occurring in our northern climates. The pulmonary symptoms often occur early and become so pronounced as to obscure the hepatic symptoms. They usually consist of a stitch-like pain and signs of exudation into the pleura in the right axillary region, dyspnea, and hacking cough with little expectoration. Later, when the abscess discharges into the bronchi, severe paroxysmal cough develops, with abundant expectoration, often greatly increased on lying down. The sputum consists of a "dirty-red or brownish puriform matter. There is no matter like it expectorated in any disease of the lung itself, and I believe that its appearance is pathognomonic of abscess of the liver, or, at least, of abscess perforating the lung" (Budd).

Flexner reported a case, probably the only one in literature in which secondary perforation of the inferior vena cava resulted.

A slight degree of jaundice is not rare; it may vary with the variations of temperature. Exceptionally more marked and prolonged jaundice is caused by pressure of the abscess on the common bile-duct. Ascites may result in a similar manner from pressure on the portal vein.

Case of abscess of the liver in connection with pregnancy. The abscess was a single large one in all but 1 of the 5 cases. Both of the women survived in the 2 cases in which an operation was done. The main point in such cases is to bear in mind the possibility of an abscess of the liver when confronted with puzzling symptoms during or soon after a pregnancy. In the 5 cases reported the diagnosis was presumptive in 1 case, confirmed by the operation; in another case the diagnosis had been positive, but in the 3 other cases

pleurisy or pleuropneumonia had been diagnosed. Chavannoz and Loubat (*Revue de gynäk.*, Dec., 1911).

Diagnosis.—As the suppurative process in the liver may be latent, it is often impossible to make a diagnosis of hepatic abscess, especially in the early stage.

The occurrence of pain in the right hypochondrium or in the scapular region, some enlargement and tenderness of the liver, and irregular fever, usually with chills more or less marked, in a case with a history of ulcerative processes anywhere in the digestive tract afford fairly certain grounds for a diagnosis.

Bertrand called attention to perihepatic friction in suppurating hepatitis as a diagnostic sign that may be perceived both by ear and hand, and precedes by several days edema of the parts.

If discharge takes place through the lung the character of the pus may be sufficient to establish the diagnosis; especially if ameba found in it, otherwise abscess of the lung or empyema will have to be excluded.

Perforation externally may render diagnosis easy. If the abscess is in the liver the needle inserted into it will move with the respiratory movements of the liver unless adhesions be so firm that the liver is quite fixed. Empyema of the gall-bladder would, of course, move with the liver, as might also an abscess adherent to the under surface of the liver.

Attacks of gall-stone colic with marked intermittent fever often closely simulate hepatic abscess. In the gall-stone cases the attacks of fever are paroxysmal, with severe pain and sweating. The attacks may recur with great regularity. In the intervals between

the attacks there is complete apyrexia, and the general nutrition is well maintained. Such a history may be continued for years.

As abscess of the liver is a secondary affection, the previous history is important. The primary disease may be dysentery, ulcer of the stomach, hemorrhoids, rectal ulcers, appendicitis, etc.

In 3 cases the leucocyte count ranged between 19,000 and 26,000. These figures are of no diagnostic value, inasmuch as a hyperleucocytosis of similar grade is found in a variety of hepatic disorders other than abscess. In the fourth case the leucocytes numbered 40,000, but here there was present an ulcerous phlebitis of the inferior vena cava. Differential counts showed an excess of polymorphonuclear leucocytes. Mosse and Sarda (*Gaz. Hebdomadaire de médecine et de chirurgie*, Dec. 26, 1901).

The writer emphasizes the importance of counting the white cells; by the absence of a leucocytosis he could rule out a number of cases of typhoid, malaria, and nephropylitis which closely simulated hepatic abscess. The white cells generally sink very slowly; if they remain high for several days and complications can be ruled out, there is probably another focus in the liver. Schlayer (*Münch. med. Woch.*, Aug. 11, 1903).

In liver abscesses X-ray plates give more information than the symptoms. Permitting of change of position of the patient, radioscopy is superior to the X-ray plate in the localization of the abscess. Exploratory puncture is indicated where X-rays are negative. I. Blanes (*Rev. Asoc. méd. argent.*, xxv, 170, 1916).

The greatest obstacle to the diagnosis at present is the lack of appreciation that amebic abscess is one of the common maladies. The clinical picture, however, is rarely complete. Fever, of varying type, is one of the earliest and most constant signs. Pain was noted in 16 of the writer's 19 cases. The pain may be

steady or intermittently sharp. Diaphragmatic involvement causes a dry cough and at times singultus. Allan (*Archives of Diag.*, July, 1917).

The existence of leucocytosis may prove of importance as indicative of suppuration. The diagnosis may sometimes be established by aspiration: an operation that may be resorted to without any great degree of danger. Of course, failure to find pus does not negate the existence of abscess, as the needle may not reach it or the contents may be too thick to enter the needle. The patient should be anesthetized, as many punctures may be required. The needle should be inserted in the lowest interspace in the anterior axillary line, in the seventh interspace in the mid-axillary line, or in the center of the dull area behind. The needle should be used only to determine the necessity for drainage.

Etiology.—Abscess of the liver results occasionally from traumatism, as from a blow or a punctured wound.

Abscess of the liver is a rare condition in children, except as the result of injury, but traumatic abscess is relatively more common in them than in adults. This relative frequency is probably due to the occurrence of blows or injuries on the abdomen, to which children are more subject than adults. Sometimes the abscess develops immediately after the injury, while at other times a latent period intervenes, during which time the symptoms are in abeyance. Generally the injury has been applied directly over the hepatic region, in which case the abscess is primary. Occasionally an abscess of the liver results from an injury to some other part of the abdomen, when the resulting abscess is secondary or indirect. The symptoms of a traumatic abscess of the liver are local pain; swelling, and fluctuation; at the same time there is fever, either remittent

or continuous, with rapid and profound cachexia in every case. The natural tendency of the liver abscess is to rupture, either through the skin or through the respiratory passages. In the latter case the abscess discharges either through the bronchi or into the pleura, setting up a purulent pleurisy or a pyopneumothorax. The evacuation is followed generally by a rapid amelioration of the symptoms, but in every case surgical intervention brings about a more certain and rapid cure of the condition. Oddo (*Rev. mens. d. mal. de l'enf.*, Jan., 1901).

Six cases of liver abscess. One was due to mechanical injury, indirectly causing a contusion of the liver, and thus furnishing a point of lessened resistance to the action of bacteria. The second was due to the direct extension of the infection from a suppurating and gangrenous gall-bladder, the abscess being formed on the under surface of the liver. Two cases were due to dysentery. In 1 case autopsy confirmed the presence of the etiological factor. In 2 cases no definite etiological factor could be assigned. Jacoby (*Med. Rec.*, April 11, 1914).

Apart from traumatism, the two chief avenues by which bacteria gain access to the liver and excite suppuration are the portal vein and the bile-ducts. Of these, the portal vein is the chief one, as it may convey germs from any part of the digestive tract; hence the frequency with which abscess of the liver follows ulcerating lesions of the intestines, as dysentery, appendicitis, typhoid fever, hemorrhoids and other rectal diseases. The formation of gall-stones is regarded as the most frequent cause of liver abscess in Germany, according to Korte. Covert witnessed a case in which the abscess gave passage to 30 gall-stones.

Persons living in hot climates are more liable to hepatic disease in the

course of typhoid fever than are others. Other than this there is nothing to suggest the possibility of abscess formation in any case of typhoid, as this complication may arise in mild or severe cases. The symptoms of suppurative hepatitis in course of typhoid are practically the same as those of any other form. They generally appear suddenly toward the fourth and fifth week, when the temperature appears to be declining. The temperature again goes up somewhat rapidly, and there may be a sharp rigor and then pain, and the other symptoms of hepatitis appear. The sudden onset of hepatitis is very similar to that of perforative peritonitis, cholecystitis, angiocholitis, or pleurisy. Cassuto (*Thèse de Paris*, 1901).

Abscess of the liver occurring as a complication or sequel of typhoid may arise independently of typhoid lesions of the gall-bladder, or ducts, pylephlebitis, or the presence of suppuration elsewhere in the body. The recognition of solitary abscess is important because of the fact that only such cases are suitable for surgical treatment. Von Eberts (*Amer. Jour. Med. Sci.*, June, 1911).

As a rule, tropical liver abscess is secondary to ameba dysentery, but alcohol and opium smoking are important factors. In 103 cases, 1893-1910, only 2 of the patients were women and only 11 were natives. Dysentery is less prevalent among the natives; their food is less harmful for the liver than the diet of Europeans, while they use less alcohol. The primary dysentery may be so mild as to escape detection or it may be mistaken for ordinary diarrhea, but dysentery is recorded as the primary cause of the liver trouble in 70 per cent. of the cases. The abscess was multiple in about 40 per cent., up to 4 abscesses in 12 cases and number unknown in 13. In 22 cases the abscess emptied into the air passages (7, with only 2 deaths); pleura (4); intestine (4); peritoneum (2); pericardium (1) or kidney (1),

with death in 14 of the 22 cases. The front upper part of the right lobe is the most frequent seat of the suppuration, a zone corresponding to the seventh, eighth, and ninth intercostal spaces. Sambuc (*Arch. gén. de chir.*, June, 1913).

Emboli from these sources may excite suppurative pyelephlebitis, from which abscesses may result by extension into the liver substance.

A case of abscess of the liver due to pyelephlebitis following typhoid fever. Schultz found no instances among 3686 patients with 362 fatal cases; Romberg saw 1 among 677 cases, with 88 deaths; Dopfer saw 10 in 927 autopsies. There was no cause for metastatic abscess nor any typhoid ulceration of the biliary passages or gall-bladder. The abscess was due to ascending thrombosis beginning in the intestines, and the bacillus of Eberth was found in the abscess. Lannois (*Rev. de méd.*, Nov., 1895).

Infective processes in the umbilical cord in infants may extend along the vein to the liver and produce one or more abscesses. In a similar manner they may result from abscess of the spleen.

In general pyemia abscess of the liver is rare, as the germs have to pass through the lungs to reach the liver. Suppurative wounds of the head are, however, followed by hepatic abscess with comparative frequency. It may possibly happen in these cases that the infective agent reaches the hepatic veins by "retrogressive embolism" from the vena cava.

Next to the portal vein, the most common avenue of invasion of the liver by pyogenic organisms is the bile-duct. The germs originate in the intestine, and the inflammation resulting from their presence in the duct is probably always preceded by injury, usually

from pressure of a gall-stone, more rarely from the irritation of a parasite or a foreign body, such as a pin, as was the case in an instance reported by Lambert.

In tropical climates there is close association between abscess of the liver and dysentery: an association apparently explained by the discovery of the presence in both of the ameba coli. But the ameba is not found in all cases of hepatic abscess in hot climates, and probably other organisms are the active agents in the production of many cases.

Morbid Anatomy.—In septic cases the abscesses are usually multiple and irregularly distributed throughout both lobes. Traumatism may give rise to a solitary abscess, and such may also result from a single embolus. The liver is usually uniformly enlarged. Its surface may present no abnormal appearance. In many cases, however, there are yellowish points showing beneath the capsule. On section isolated pockets of pus are found varying in size from a small point up to 3 or 4 mm. or more in diameter, the larger ones being probably formed by the coalescence of two or more smaller abscesses. Many are dendritic in form, and on examination are found to communicate with the portal vein, being doubtless formed by suppuration of its branches. The walls of the abscesses are shreddy, especially in the larger ones, and the cavity may be divided by many trabeculae. The contents vary according to the age of the abscess and the nature of the infective agent: they may be thick and viscid; or fetid, bile stained, and containing masses of necrotic tissue; or the pus may be thick and laudable. All the branches of the portal vein in the liver may be involved, but sometimes thrombi circumscribe the

infection and preserve sections of the liver from invasion. The suppurative process may extend backward even into the gastric and mesenteric veins.

Liver abscess and appendicitis. Reginald Fitz in 257 appendicitis found 11 examples of suppurative phlebitis and hepatitis; Langheldt in 112 autopsies of appendicitis shows 4 cases of phlebitis and thrombosis, 2 of abscess of the liver, 2 of suppurative hepatitis, 2 of perihepatitis; Einhorn in 100 appendicular post-mortem examinations found 6 complicated by infectious embolism of the portal vein, accompanied by pyophlebitis and by secondary abscess of the liver; Coley among 200 cases of appendicitis notes 2 of the liver and 1 of subphrenic abscess. E. Loison (*Revue de Chir.*, p. 522, 1900).

Analysis of 79 cases from the Institute of Pathology and Anatomy of Vienna. Thirty-one of these occurred in connection with occlusion of the bile-ducts (23 gall-stones, 7 carcinoma, and 1 *ascaris lumbricoides*). Seventeen were secondary to disease in the portal area (6 disease of the female genital organs, 4 dysentery, 3 typhlitis, 1 pancreatic abscess, and 1 suppurating hemorrhoids).

Pyemia accounted for 13 cases, while in 18 of the cases either the cause was not discovered or arose from *echinococcus* (8 cases) or contiguous suppuration (4 cases). Kobler (*Virchow's Archiv*, B. cxii, H. 1, 1901).

If infection has taken place through the bile-ducts, obstruction by gall-stones usually exists and the gall-bladder and the bile-ducts generally may be dilated and full of pus, often bile stained.

Very large abscesses may result from suppuration around *echinococcic* cysts; their nature is indicated by the presence of portions of the cysts.

TROPICAL ABSCESS. — There may be one or more; in the latter case

there is usually one larger and evidently much older than the others. They may vary in size from a few millimeters in diameter up to an orange or even to a child's head. The larger abscesses usually occupy the right lobe, being situated, as a rule, at the under surface above the hepatic flexure of the colon or in the dome of the liver (Lafleur). In Waring's statistics of 300 cases, in 62 per cent. there was only a single abscess. The small multiple abscesses are usually superficial. In the smaller abscesses, being more recent, the walls are shreddy and not sharply defined from the contiguous inflamed liver substance. Their contents vary from a yellowish gray to a reddish brown (due to the presence of blood), and often contain shreds of necrotic liver tissue. In old abscesses the walls are firm, thick, and fibrous. The contents of all the abscesses are chiefly remarkable for the small number of leucocytes that are present.

When the abscess reaches the surface it may rupture and pus escape into the peritoneal cavity, or, adhesions having previously formed, the pus may penetrate in any direction. It may discharge into the stomach, the intestine, the pelvis of the right kidney, or through the diaphragm into the pleural or pericardial sac. Adhesion of the lung to the diaphragm usually precedes its advent in this direction, and then the lung is invaded, an abscess forming and discharging into the bronchi. It may also perforate the thoracic wall and appear beneath the skin.

Prognosis. — Suppurative hepatitis is a grave disease, the mortality being over 50 per cent. In rare cases of single small abscesses and of mild cases of pyelophlebitis recovery possibly takes place by absorption or inspissation and

calcification of the pus. There is, however, room for doubt as to the diagnosis of such cases. Multiple small abscesses are almost necessarily fatal, as they can rarely be evacuated either by natural processes or by surgical intervention. In large abscesses the mortality has been greatly reduced of late by the greater fearlessness and thoroughness with which they are operated on. Operation appears to give much better results in the ordinary septic abscesses than in the amebic variety.

Review of 94 articles that have appeared on this subject and the details of 25 cases of solitary abscess in the liver of typhoid origin. The prognosis is unfavorable when the abscess develops from spread of a typhoid cholecystitis or thrombophlebitis. The clinical picture of typhoid appendicitis resembles that of typhoid perforation of the bowel. In 5 cases the typhoid appendicitis was responsible for development of a pylephlebotic liver abscess, all fatal. E. Melchoir (Centralbl. f. d. Grenzgeb. d. Med. u. Chir., May 19, 1910).

Treatment.—Apart from surgical means, little can be done, beyond relieving symptoms and maintaining the patient's strength until the abscess discharges spontaneously or is accessible to the surgeon. Pain and cough are the chief symptoms to be relieved. In cases of rupture into the bronchi, cough is necessary for the removal of the pus, and should not be interfered with unless excessive. **Ipecacuanha** and particularly **emetine hydrochloride** are useful to prevent the development of abscesses and may prove curative even when the latter have formed, especially if **aspiration** and **drainage** can be carried on simultaneously.

The writer's experience leads him to believe that 90 per cent. of amebic abscesses of the liver can be pre-

vented by the use of large doses of **ipecac**. The drug must be given in freshly made pills or bolus, no food or drink being given for several hours before and after the dose, which is best given once a day in the evening. Vomiting must not be produced, particularly if abscess has already formed. To prevent it, **tincture of opium** or **chloral hydrate** may be given about twenty minutes before the ipecac; or the ipecac may be put up in keratinized capsules, which do not dissolve before reaching the intestine (Rogers); or the pills may be coated with melted salol (Grubbs). The daily dose is from 30 to 60 grains of ipecac, continued for at least two weeks, but at increasing intervals. L. Rogers (Arch. of Intern. Med., June, 1908).

Ipecacuanha or **emetine** should be given in hepatitis associated with dysentery in the hope of preventing pus formation, and it is possible that the drug may, by destroying the organisms, actually cause a threatening intrahepatic abscess to abort; but that it can resolve an established abscess is to be regarded as improbable, and that pus beyond the liver—suprahepatic abscess—can be affected by the drug is inconceivable. The point of transition from safety to danger during the ipecacuanha treatment is obscure. J. Cantlie (Jour. Trop. Med. and Hygiene, Nov. 15, 1913).

Case of a large amebic abscess of the liver that after about a year perforated into a bronchus. When the emetine treatment was begun the patient had been for five months raising a considerable amount of reddish pus, averaging each day from 200 to 250 c.c., and during this time had become emaciated and septic. At the same time there was some ulceration in the rectum. The X-ray examination showed an opacity at the base of the right lung merging with the shadow of the liver. The patient was given 6 injections of **emetine hydrochloride**, each 0.04 Gm. ($\frac{3}{4}$ grain), during a period of five days. The

injections were practically painless and produced no local induration. The expectoration was reduced to but a slight amount on the fifth day of the treatment, and after that it stopped entirely. The temperature fell to normal and the leucocyte count dropped from 49,000 to 19,800, and the polynuclear from 77 to 63 per cent. The ulceration in the rectum healed and subsequent X-ray examinations showed that the base of the right lung had cleared up. The patient improved markedly in general health and increased in weight 13 pounds. This experience with the clinical results reported by others demonstrates that emetine is a specific for amebic disease like quinine for malaria. Chauffard (Bull. de l'Acad. d. Méd., vol. lxxvii, p. 122, 1913).

Where **aspirating apparatus** are not available, as sometimes happens in outpost hospitals, the **abscess** can be **emptied by means of a large trocar and cannula**, and the cavity then irrigated with **saline solution**, to which has been added, on the last two occasions, a fluidram (4 c.c.) of **tincture of iodine** to the pint. Four fluid-ounces (120 c.c.) of a 10 grain to the fluidounce (0.65 Gm. to 1 c.c.) solution of **quinine bihydrochloride** were injected after each of 4 operations in a personal case, and the opening in the skin and deeper tissues closed by a single stitch. Powdered **ippecacuanha** was given by mouth in 30-grain (2 Gm.) doses at first, and in smaller quantities toward the end. The patient was discharged cured on the forty-second day, and there has been no recurrence. The procedure described can be done under **local anesthesia**. **Emetine hydrochloride** should now be on hand in every dispensary, both for treatment of acute and chronic amebic dysentery and for use in amebic hepatitis and liver abscess. L. G. Fink (Jour. of Trop. Med. and Hyg., Nov., 1912).

Of 35 patients with liver abscess treated by the writer with **ippecacuanha**, 21 were only **aspirated**: of

these, 17 were cured and 4 died. Five patients were treated by **aspiration** followed by **drainage**; of these, 3 were cured and 2 died. Nine were treated by drainage alone; among them 5 were cured and 4 died. The results are therefore largely in favor of aspiration alone. Of 32 patients treated with **emetine**, 27 were subjected to aspiration alone; of these, 20 recovered and 7 died; 2 were dealt with by aspiration followed by drainage; 1 patient was cured, the other died. Patients treated by drainage alone were 3; of these all recovered; these were all abnormal cases. Adding together these two series of cases, we get for aspiration alone a total of 48 cases, of which 37 patients were cured and 11 died, i.e., a percentage mortality of 23. For aspiration, plus drainage, 7 cases, with a mortality of 3, i.e., 43 per cent. Of 12 cases treated by drainage alone, 4 died, a mortality of 33 per cent., a verdict very much in favor of aspiration alone. Thurston (Indian Med. Gaz., March, 1914).

In multiple abscesses and in suppurative pylephlebitis surgical measures are useless unless to open an abscess threatening to rupture. In single abscesses operation may promise fair success, especially in the non-amebic cases. In cases in which the abscess is discharging through the lung operation should be deferred if the patient's condition is favorable, as some recover spontaneously.

The successful treatment of tropical abscess by **surgery** depends on its being single, or at most double. The symptoms are often indefinite, comprising chiefly weakness and lassitude, loss of flesh, a sallow, muddy complexion, and sensations of chilliness or actual rigors. Pain in the right shoulder is a time-honored symptom of abscess in the upper part of the right lobe of the liver, and is explained by radiation along a small branch of the subphrenic nerve, which communicates with the nerve to the subclavius muscle. Enlarge-

ment of the liver in an upward direction is almost pathognomonic of liver abscess, but it is not easy to recognize. The chief difficulty in diagnosis in abscess of the liver arises from its simulating disease of the right lung or pleura, or from its being complicated with actual effusion into the pleura. Bradshaw (Lancet, Jan. 18, 1908).

The only safe method of treatment is by **incision** and **drainage**, the route selected, either abdominal or transpleural, depending on the location of the abscess. Preliminary transperitoneal puncture should not be practised owing to the danger of leakage and peritonitis. In future observations on such cases, the writer urges that the scope of bacteriological investigations should include the use of media especially suitable for the cultivation of *Bacillus typhosus*, as well as careful search for amebæ. Von Eberts (Amer. Jour. Med. Sci., June, 1911).

Dieulafoy stated that infection of the liver from acute appendicitis is always fatal, but the writers found 14 cases in which the infectious focus was single or there were but a few foci, and in which **operative measures** cured 12 of the patients. The operation was done through the pleura in 8 cases, generally on account of a vomica or because the tumor pushed up the diaphragm. Three previously unpublished cases are described in detail. The patients were a man of 32, a woman of 36 (syphilitic), and a child over 10. All are in good health to date, years after the operation. E. Quénu and P. Mathieu (Revue de chir., Oct., 1911).

Experiences in the **surgical treatment** of 24 cases of abscess of the liver consequent upon amebic dysentery. The writer emphasizes the facts that deep liver abscesses do not fluctuate, but can be detected with a hand placed on the liver surface by a feeling of induration; that a large percentage of them develop from a focus high in the upper half of the

right lobe, at such a point that perforation into the lung is the most probable termination without surgical interference, and that the mortality of any surgical procedure is greatly increased after the lung has become involved. A cough developing in the course of liver abscess indicates immediate operation, unless it can be attributed to causes other than a beginning lung involvement secondary to liver infection. By keeping the patient in Fowler's position after operation, the lung complication can be entirely avoided. Rea Smith (Calif. State Jour. of Med., July, 1912).

When the diagnosis is doubtful the abscess should be attacked through the abdomen. The abdominal cavity should be well protected with gauze and every **abscess opened** with blunt instruments, or better with the finger; all **cavities** should be well **cleaned** with gauze and not irrigated. The external medication should be changed every six or eight hours; the deep drains should not be changed for a week. Sometimes it is advisable to clean the abscess cavities with gauze soaked in solutions of **formaldehyde**, **hydrogen dioxide**, or **quinine**. The mortality in these patients is still high. Of the cured some are permanently well; recurrence is rare; when this happens, all the patients operated upon a second time recover. Giordano (Riforma Medica, May 25, 1912).

Aspiration is the writer's method of choice. It should always be attempted even in apparently desperate cases. The puncture should be made in the posterior axillary line as high up as possible. No general anesthetic should be given and 1 grain (0.065 Gm.) of **emetine** should be injected hypodermically while the patient is in the operating room. **Incision** and **drainage** should be performed for the abscess of the left lobe and abscesses that are pointing, particularly if there is no great general enlargement of the liver. Free drainage by large rubber tubes

should be provided. A combination of these methods is indicated when aspiration has not induced recovery. Sandes (Indian Med. Gaz., Mar., 1914).

TUMORS OF THE LIVER.

Of these, *secondary carcinomata* are, by far, the most common. *Primary carcinoma, sarcoma, angioma, and lymphadenoma* also occur. *Myxoma, cysto-sarcoma, and fibroma* are rare forms. Cancer of the liver is met with in about 3 per cent. of deaths from all causes, and in all persons affected with cancer the liver is the seat in 50 per cent. of the cases, the liver being third in order of frequency of internal cancer.

CARCINOMA.

SYMPTOMS.—In many, perhaps half, of the cases of cancer of the liver there are no symptoms by which the disease can be recognized during life. The symptoms of the primary growth usually overshadow those caused by the liver disease. The stomach is the seat of the primary growth in more than a quarter of all cases; so that symptoms of digestive disturbances are usually prominent, such as loss of appetite, distress after food, nausea, and vomiting. Progressive loss of flesh and strength is an early symptom. Pain and uneasiness in the hepatic region are common, but in many cases of even extensive disease of the liver neither is present. No doubt both are often due to local peritonitis.

Case of primary carcinoma of the liver. This is a rare condition, occurring only in 0.28 to 3 per cent. of all autopsies from various statistics. It is most frequent in adult males, but may occur at any age, a number of cases having been described in infancy. Clinically, the disease is difficult to differentiate from hepatic cirrhosis, though the

rapid course, presence of an enlarged irregularly nodular liver, and hemorrhagic ascites may aid in diagnosis. The tumor may occur in normal or diseased livers. Very commonly it is combined with a cirrhosis; the latter, it is believed, precedes the tumor, but this, in turn, may cause fibrosis secondarily. Winternitz (Bull. Johns Hopkins Hosp., June, 1912).

The liver is usually enlarged. Hepatic dullness may extend upward to the fifth rib in the midaxillary line, to the left as far as the spleen, and the lower edge may be felt at or below the umbilicus. The lower edge and anterior surface below the costal margin are hard and often uneven on account of the nodular deposits. The nodules in some cases are felt to be umbilicated: an absolutely diagnostic sign. In cases of diffuse infiltration the liver may be very large; occasional instances are met with in which it is smaller than normal. The surface is smooth and hard and usually tender.

Jaundice is present in about half the cases. It is usually slight at first, becoming deeper toward the end. It is usually due to pressure on the common bile-duct in the transverse fissure by carcinomatous glands; it may be due to pressure on the branches in the liver by growing nodules, or if the primary growth is in the head of the pancreas it may press on the common bile-duct. It is important to remember that cancer of the liver is the most frequent cause of long-standing jaundice; it is permanent, and in the later stages may become extremely deep.

Ascites occurs in some cases, and is caused by pressure on the portal vein or to extension of the cancer to the peritoneum. It is present in the cirrhotic form of cancer.

The superficial veins are enlarged. Some fever is not rare, continued or intermittent, especially when the disease runs a rapid course. It may occur in simple cancer, or may indicate suppuration. Hemorrhages into the skin or from the mucous surfaces may occur late in the disease.

Cancer of the liver tends to cause complications of various kinds which hasten the fatal outcome. Besides infections in the parotid glands, lungs, pleura, and peritoneum, there is a special tendency to local hemorrhage. Ascites may develop early with cancer of the liver and hemorrhage. This combination occurs with adenocancers and with liver tumors with cancerous invasion of the portal vein or its simple obstruction. Early death with cancer of the liver may be due to a subacute jaundice from hepatitis with secondary, galloping, local malignant disease. Or it may be the result of autogenic intoxication, acidosis, and acetonemia. M. Loeper (*Arch. des mal. de l'app. digestif*, Sept., 1911).

Death usually results within a few months; it is rarely delayed beyond a year after the symptoms have declared themselves. Occasionally the progress is delayed for some weeks at a time, during which some improvement may take place in the general condition. Death is usually due to progressive debility, with, in the last stage, some infection that closes the scene.

DIAGNOSIS.—The occurrence of progressive loss of flesh and strength, of pain and tenderness in the hepatic region, and of rapid enlargement of the liver, with the formation of nodules, forms a fairly sure basis for diagnosis. Even with this symptom group, difficulties may beset us. Hanot states that some cases of hepatic cancer closely resemble the

terminal stages of heart disease. But in the latter, slighter diminution of urea and albuminuria present, whereas absent in cancer, are the main differential points.

In the differential diagnosis between malignant and echinococcus disease of the liver, the age, over 50, speaks in favor of cancer; also a sudden onset of intense pain, enlargement of the liver, hard nodes on palpation, absence of eosinophilia and of leucocytosis in general, reduction of nitrogen and increase in urobilin in the urine, and coexistence of stomach trouble. The growth is more apt to be a sarcoma than a carcinoma if there are no extra-abdominal metastases, ascites, or jaundice. Ferranini (*Riforma medica*, xxxii, No. 44, 1916).

Apparent enlargement of the liver may be due to hardened feces in the transverse colon, which is tender, owing to the enteritis caused by the hard masses. Indurated puckered omentum and tumors of the stomach, kidney, and the abdominal wall may also simulate a large liver. The large cirrhotic liver may, in the early stage, be mistaken for cancer, as the liver is large and the jaundice usually well marked; but the liver is smooth and not tender and there is absence of the cachexia of cancer. The spleen is also large.

Syphilitic disease in which there is large amyloid liver with gummatous nodules may present some difficulties, as may also echinococcal liver with large cysts. In both, the history is more prolonged and there is absence of cachexia and usually of jaundice. Ascites is strongly indicative of cancer. The early period of cancer with cirrhosis may be indistinguishable from atrophic cirrhosis; there is similar jaundice and

ascites in both, but later the cachexia is more marked in the cancerous form.

Melanosarcoma usually involves other organs as well. It may cause great enlargement of the liver. Secondary tumors may form in the skin. In many cases there is melanuria—a characteristic symptom. Great difficulty is often experienced in differentiating cancer of neighboring organs from cancer of the liver, especially if they are adherent to the liver.

The chief interest in tongue-like accessory lobes of the liver is in connection with the diagnosis of abdominal tumors. Unless fully alive to the great variety, as to shape and position, in which the accessory lobes of the liver may present themselves, one will often be misled.

ETIOLOGY.—Cancer of the liver is most frequently secondary to cancerous disease in the organs connected with the portal circulation. Hence it occurs secondarily to cancer of the stomach, rectum, colon, esophagus, gall-bladder, bile-ducts, and pancreas. It also follows cancer of the uterus and ovaries and the mammary gland.

Tumors of the liver occurring as primary growths are very uncommon. They may spring from the epithelial structure, adenomata and carcinomata representing this type, or from the connective tissue, as represented by fibroneuromata and sarcomata. Secondary carcinomata follows a primary growth in the stomach in about 25 per cent. of the cases. G. R. Fowler (Medical News, Feb. 8, 1902).

Four cases of primary hepatic carcinoma. The first 3 cases assumed the form of malignant adenoma, which was observed twice in cirrhosis of the liver and once in *hepar lobatum*

syphiliticum. The writer favors the view, held also by others, that cirrhosis or syphilitic cicatrization is the primary affection and the carcinoma development secondary; in both cases the liver was diffusely infiltrated with small tumor nodules, surrounded by dense connective tissue, which in one case had formed metastases also in the pleura. M. Lissauer (Virchow's Archiv, Bd. 202, S. 57, 1911).

It occurs usually in late adult life, especially between the fortieth and sixtieth years, but may occur in children. The relative frequency of its occurrence in the sexes is doubtful; some observers state that it is more frequent in males, others in females. My own experience coincides with the former. Injury is a doubtful cause and cancer of the bile-ducts is frequently associated with gall-stones, but whether as a cause or a result is uncertain.

MORBID ANATOMY.—As the primary growth is situated in some organ whose blood is carried to the liver by the portal vein, the liver becomes early affected, and often is the seat of large deposits at the time of death. The deposits are in the forms of whitish nodules scattered irregularly throughout the liver just as we would expect, in view of infection through the blood of the portal vein. The nodules vary in size from a microscopical point up to a mass occupying a large portion of the organ. As they grow in the direction of least resistance they appear early beneath the capsule, and if the abdominal wall is thin they may be felt and even seen through it. They may be firm from fibrosis or soft from degeneration; the former shows umbilication on the surface, owing to contraction of the fibrous tissue. The

masses are globular, but coalescence may result in the formation of large irregular masses presenting, on section, a striking contrast to the liver tissue. Their color may be bright yellow, from bile staining; dark red, due to hemorrhage; or pale yellow, from fatty degeneration.

The secondary cancers are of the same structure as the primary one from which the infection was derived—usually alveolar or cylindrical carcinoma. The peritoneum over them may be thickened and strong adhesions formed with the abdominal wall or diaphragm. Usually some of the bile-ducts are compressed, obstructing the flow of bile.

Primary Cancer of the Liver.—Of this there are three forms:—

(a) A single large tumor with well-defined boundaries. It is usually grayish white, but may be the seat of hemorrhage.

(b) *Nodular growths* are the most common, and the whole liver resembles the appearance it presents when it is the seat of secondary carcinoma.

(c) *Cancer with Cirrhosis.*—This is a remarkably rare form. In it the cancer cells are uniformly diffused through the liver, so that the fibrous tissue is increased in all directions. This may contract and cause the liver, which at first is enlarged, to become smaller than normal. The organ looks like a coarse cirrhosis. When cut there are wide white bands seen running through the organ, the gland-tissue between them having vanished. Secondary growths in other parts of the body scarcely ever occur. Out of 258 cases recorded in the Berlin Pathological Institute in ten years, only 6 cases were true pri-

mary cancer of the liver, and of these 2 are doubtful.

Sarcoma.—Two forms of sarcoma occur, primary and secondary. The primary cannot be distinguished at the bedside from carcinoma, and even after death it is often difficult to differentiate them. The disease is extremely rare.

Secondary sarcomas of the liver exactly reproduce the form of the original growth. The patient usually dies before any symptoms are produced by them. Melanosarcoma is the most important form; it develops in the liver secondarily to sarcoma of the eye or of the skin. It is very rarely primary. The liver is greatly enlarged, and is affected by uniform infiltration or by nodular black masses. In the former case the cut surface is studded with black or brown granules.

There are usually metastases, affecting in some cases every organ in the body. Nodules of melanosarcoma in the skin may guide to the diagnosis (Osler).

Angioma.—Cavernous angiomata are common, but produce no symptoms during life. They occur as small, reddish bodies, and consist of dilated blood-vessels. They have, in children, occasionally produced large tumors.

TREATMENT.—As cancer of the liver is invariably fatal, nothing can be done unless it be through surgery.

Analysis of 76 cases of resection of the liver for hepatic neoplasms. The termination in the case of 2 patients was uncertain; of the remaining 74, 63 recovered, the operative mortality thus being 14.9 per cent. Shock, hemorrhage, and exhaustion caused death in 8 instances; septicemia in 2, and pulmonary embolism in 1. Four-

fifths of the patients were females, this proportion being attributed to tight lacing. Echinococcic and hydatid cysts were found in 20 instances; carcinoma in 17; syphiloma in 2; adenoma in 7; sarcoma in 5, and rarer forms of new growth in single instances. An early exploratory celiotomy advocated in every case. Keen (Annals of Surgery, Sept., 1899).

Portions of liver tissue of considerable size may be safely removed by previously rendering anemic the part which it is intended to remove. For the support of the ligatures, living tissue from the same animal, preferably the fascia and peritoneum from the abdominal wall, is best suited. The intraperitoneal or the intraparietal method is preferable to the external method. Carl Beck (Jour. Amer. Med. Assoc., April 26, 1902).

New method of exposing the liver through the posterior surface of the right lobe. The patient, which the writer reports, was believed to have a tuberculous right kidney. There was pain on pressure in the lumbar region, which was believed to be due to the kidney. The latter was exposed from behind after resecting the twelfth rib and then pushed to one side after being freed from its attachments. The posterior aspect of the right lobe of the liver was thus exposed and on it was seen a tumor, which was removed. It proved to be a gumma and the patient made a good recovery under appropriate treatment. Although there may have been some doubt as to the propriety of surgical intervention in this case, still the advantage of reaching this region of the liver was shown. It is indispensable, however, that the pedicle of the kidney is sufficiently long to permit pushing the kidney to one side. J. Israel (Deut. med. Woch., Mar. 31, 1904).

Case of pedunculated primary parenchymatous adenocarcinoma of the liver in an infant 10½ months old. It

is the first case reported in which complete surgical excision was done. There was a good surgical convalescence, with death sixteen days after operation from symptoms of acute enteritis. Castle (Surg., Gynec., and Obstet., Apr., 1914).

HYDATID CYST OF THE LIVER.

SYMPTOMS.—Small cysts cause no symptoms; they may be discovered at the autopsy. Cysts may reach considerable size without causing inconvenience and be discovered as a tumor-like enlargement accidentally.

Most writers on hydatid cysts of the liver simply state that there is generally no pain except in the suppurating cysts. The writer, in an analysis of a large series of cases, finds that pain is a common symptom even in the earlier stages of the disease, and is even more frequently present during the course of the affection—independent of any suppuration or rupture of the cysts. E. Quénu (Revue de chir., No. xi, 1910).

The liver enlarges irregularly and in time the cyst causes disturbance by pressing on some neighboring organ or part, interfering with its function. If in the dome of the liver it may displace the heart or lungs. It may press on the bile-passages, jaundice resulting; or on the portal vein, causing ascites. If it presses on the vena cava it causes edema of the legs. If superficial, the cyst may fluctuate on palpation, or, if tense, it may be felt as a hard solid mass. *Hydatid thrill* is sometimes obtained by placing one hand lightly on the cyst and tapping it gently with the fingers of the other hand. The thrill has been ascribed to the sudden impact of the daughter-cysts against each other and against the wall of the cyst; but thrill is sometimes ob-

tained in cysts which contain only clear fluid.

Rupture of the cyst may occur. If it takes place into any of the serous cavities inflammation results. The pleura suffers most frequently; perforation of the lung often follows, with pneumonia and the expectoration of cysts and hooklets. More often pus, blood, and bile pigment are coughed up, such as occur in gangrene or abscess of the lung secondary to liver abscess.

The cyst may rupture into the stomach, as proved by the vomiting of cysts and hooklets; or into the intestine, with the appearance of these bodies in the feces, as would occur also if rupture takes place into the bile passages. Rupture may occur into the pelvis of the right kidney followed by the presence of the hooklets and cysts in the urine.

The term **gaseous cyst** suggests a condition analogous to that which occurs when air enters the pleural, pericardial, mediastinal, or peritoneal cavity. The condition was first referred to by Laennec as the result of the perforation of a hydatid cyst into the stomach, intestine, or lung, while Kunde subsequently described the opening of such cysts into the lung, observing that air passed from the lung into the hepatic cyst and agitated the fluid which it contained. In 51 collected cases of gaseous hydatid cysts of the liver one of the signs considered noteworthy was a clear tympanitic percussion note at the upper limit of the tumor. This is due to the presence of the stomach behind the cyst, before it has ruptured, or it may be due, on the other hand, to the formation of gas within the suppurating cyst. Other significant symptoms are the peculiar discoloration of the skin, pain in the region around the tumor, and sub-acute peritonitis which develops when

the cyst ruptures spontaneously. Dévé (*Revue de chir.*, June 10, 1907).

Apart from such accidents, the symptoms may consist only of trifling discomfort in the hepatic region.

Rupture of the cyst is often followed by severe urticaria; it has been attributed to a toxic material in the fluid. It may also follow aspiration of the cyst.

Incidence and fatality of hydatid disease in New South Wales from a study of 420 cases. Epidemics, so to speak, of the disease have occurred at periods some five or six years later than a year of exceptional rainfall, as shown by the meteorological statistics. The fact that in dry seasons in country districts vegetables are comparatively scarce, while they are plentiful in wet seasons, explains the liability to infection from eating raw vegetables or preparing them for table during the wet season, while it is supposed that it takes five or six years for the disease to manifest itself after ingestion of the ova. Children are rarely affected, the greatest mortality occurring in middle life. The liver is affected more often than all other organs put together, then the peritoneum, and next the lungs. Mac Laurin (*Austral. Med. Gaz.*, Oct., 1907).

DIAGNOSIS.—This is rarely possible before the cyst has attained considerable dimensions; then the irregular enlargement of the liver for a long period, with the preservation of health, indicates hydatid disease. It may be necessary to aspirate the cyst, and, if hooklets are found in the fluid, the diagnosis is confirmed. A fluctuating tumor in the epigastrium is suggestive; it may give fremitus and be within easy reach of the aspirator-needle. Abscess of the liver is differentiated by the absence of symptoms of suppuration. It will not be possible to distinguish a sup-

purating hydatid cyst unless the hooklets be found in the fluid. Cancer has been closely simulated by suppurating cyst. The clinical history usually serves to differentiate it. Dilated gall-bladder and hydronephrosis have been mistaken for hydatid cyst. A more common error is the mistaking of a cyst of the dome of the liver for right pleural effusion. Subdiaphragmatic abscess, and purulent pleurisy secondary to rupture of a cyst are conditions difficult or impossible to distinguish unless the hooklets are found in the fluid.

In hydatid cysts of the liver, according to Ségond, a preliminary puncture with the aspirator should always be performed, as it establishes the diagnosis and may effect a cure.

Eichhorst called attention to a peculiar symptom observed in 2 cases of hydatid cyst which he believed to be of great value in the diagnosis of impending or actual perforation of the cyst, viz., a highly characteristic aromatic odor, resembling that of boiled plums. Weinberg has found that the blood contains antibodies against echinococci and proposed this observation as a test.

The writer reports from Metchnikoff's laboratory at Paris 52 cases in which the diagnosis was confirmed by the findings of the complement-fixation test. The blood was found to contain specific antibodies against the echinococci; in 26 of the 27 cases with positive findings the operation revealed the parasites. In 1 case with negative findings the operation revealed a hydatid cyst and the test, twenty days later, induced a positive reaction. The test in hydatid cyst disease seems to be even more constantly positive than the similar test for syphilis, and it is proving an important clinical aid. Weinberg (*Ann. de l'Inst. Pasteur*, June, 1909).

In view of the relative frequency of suppurative hydatid cysts in the liver the complement-fixation test is extremely valuable in case of positive findings, but it is baffling to obtain a negative response when the operation reveals a large hydatid cyst, as in a recent case in the writer's experience. The cyst was filled with fluid, but without daughter-cysts. The writer gives the details of a number of other cases in which the diagnosis was difficult. Fever and local and radiating pains are the most instructive features. Lejars (*Semaine méd.*, March 22, 1911).

Case of cancer of the stomach and liver in which Weinberg's serum reaction was strongly positive. The autopsy showed complete absence of hydatid disease. The reaction cannot, therefore, be considered absolutely pathognomonic of the latter affection, though it is unquestionably of great value. Lesieur, Kocher, and Aigrot (*Lyon méd.*, Dec. 14, 1913).

The term hydatid is applied to the bladder worms, which are the larval forms of the *Tania echinococcus*: the minute tape-worm of the dog family. When fully grown the parasite is not more than 4 mm., or $\frac{1}{16}$ inch long. It consists of 4 segments, of which the last alone has fully formed sexual organs. It is very common in dogs of Iceland and Victoria (Australia); also in the Icelandic settlements in Manitoba (Canada), the dogs having been brought from Iceland. The ova of the echinococcus are expelled with the excrement and find their way into the alimentary canal of man by water and green vegetables; also by direct contact with infested dogs, to the hair of which ova adhere and may be carried to the mouths of those who touch the dogs. The disease is rare in Canada and the United States, as well as in European countries, because the dogs are rarely in-

festated, else, of necessity, hydatids would be of frequent occurrence among all classes, irrespective of habits as to cleanliness.

Case of hepatic cyst in a woman aged 60. She had all the evidences of malignant disease: loss of weight, cachexia, and the presence of an epigastric tumor. On exploratory operation there was discovered near the middle of the left lobe of the liver a smooth, bluish-domed mass about 3 inches in diameter. This mass was tapped and yielded a colorless fluid under high pressure. The cyst was emptied and drained and the patient made an uninterrupted recovery. Cotton and Burgess (Boston Med. and Surg. Jour., Feb. 15, 1912).

MORBID ANATOMY.—The ovum, having entered the human stomach, loses its covering by digestion, setting free the larva, which, by its hooklets, burrows through the intestinal wall. Some of them meet with and enter a branch of the portal vein and are carried to the liver, where they lose their hooklets, and their cystic development begins. The cyst contains a clear non-albuminous fluid inclosed in a capsule of two layers. There is an outer, thick, homogeneous, laminated, elastic membrane which coils upon itself wherever cut and if withdrawn displays a tremulous motion. This is the *ectocyst* of Huxley. Within and closely in contact to this lies the *endocyst*: a delicate, thin, soft, granulated membrane, forming the vital part of the bladder worm. Outside the capsule there is usually a thick investment derived from the tissues of the infested organ. After the cyst has attained considerable size buds are produced from the inner membrane, which gradually develop into cysts having the two walls identical with the

parent cyst. From these daughter cysts similar buds develop and from a tertiary series—the granddaughter cysts, and so on indefinitely. In time each of these cysts severs its attachment to the parent and becomes independent. From the inner membrane or endocyst of all these cysts buds arise and become transformed into scoliosis, or echinococcic heads, presenting a circle of hooklets and form sucking disks. Each of these, transferred to the intestine of a dog, may develop into a tape-worm. The exact manner of the development of these buds is in dispute. It is thus apparent that there is a striking contrast between the development of this parasite and of the *Tenia solium*. The ovum of the latter develops into only one larva capable of producing only one tape-worm, while the ovum of the *Tenia echinococcus* produces a larva capable of multiplying itself indefinitely, so that from it an innumerable number of tape-worms may result.

The hydatid cyst is usually single, the daughter cysts being within the cavity of the mother cyst, which may be of enormous size, filling the abdomen and pushing the diaphragm high into the thorax. The liver tissue is atrophied in proportion to the size of the cyst; that is, the pressure to which it is subjected. The parasite may die. Then the fluid becomes absorbed, the capsule shrivels, and within its remains are found fat drops, cholesterin crystals, and hooklets. The capsule may become inflamed and an abscess result.

In lower animals the cyst may be multiple, the daughter cysts developing outward from the mother cyst: exogenous.

A third form is multilocular. In this the daughter cysts are surrounded by fibrous tissue and all become consolidated into a multilocular mass resembling a colloid cancer, for which it was formerly mistaken.

PROGNOSIS.—Hydatid cyst of the liver is a serious disease, proving fatal in about 25 per cent. of the cases. The course of the disease is chronic, sometimes lasting as long as thirty years. Recovery may follow death of the echinococcus, which occurs occasionally, possibly from escape of bile or blood into the cyst. As a rule, the cyst ruptures on account of its continued increase in size. The rupture may take place into the peritoneal cavity and is usually fatal from shock; the fluid, being sterile, does not cause peritonitis. If inflammatory adhesions to the stomach, small intestine, colon, or right kidney have preceded the rupture the cyst may rupture into one of these organs, with discharge of the fluid by vomiting, diarrhea, or with the urine. If the cyst is situated in the dome of the liver it may rupture into the pleura or pericardium. The latter is fatal, but recovery may follow discharge through a bronchus. Rupture may occur into the hepatic vein, or the vena cava, and cause sudden death. The cyst may open into the bile passages and recovery follow, although grave symptoms usually result from obstruction and secondary infection.

The most favorable result is by adhesion to the abdominal wall and perforation externally, usually near the umbilicus. The cyst frequently suppurates, pyogenic organisms gaining access to the cavity by the blood or bile, or from a neighboring inflam-

matory focus. As in abscess, the pus here also is said to be usually sterile.

TREATMENT.—Operation alone offers hope of relief, and brilliant results have followed such intervention. The simplest operation consists in **aspiration**, and is frequently successful. If not successful **injection of antiseptic fluid** should be resorted to. Various antiseptics have been recommended, the last of which is probably **silver nitrate solution (1:500)**. It is said to act by precipitating the chlorides and leading to the death of the parasite.

Case of hydatid cyst of the liver and a case of abscess of the liver, both of which were treated by **trans-pleural drainage**, a portion of the ninth rib having been removed. In order to shut off the pleural cavity the cyst in the first patient was sutured to the tissues of the chest wall, and in the second patient the same result was achieved by the suturing of the viscera to the parietal layer of the pleura. Both patients recovered. Newbolt (Brit. Med. Jour., Jan. 24, 1903).

Instance of sudden death of a child of 5½ years of age, nineteen hours after operation for a hydatid cyst in the liver. The urine contained no formaldehyde and this, with the results of extensive experimental research, excluded the possibility of intoxication from the small amount of this antiseptic injected. The writer found on record 12 cases of mild intoxication after puncture of an echinococcus cyst and 15 cases of severe symptoms of the kind, with 12 fatal cases and 3 in which the patients died soon after puncture of a hydatid cyst in the lung. He reviews also 36 cases of mild postoperative intoxication of the kind and 20 fatal cases. Study of this material and of the symptoms presented have convinced him that the whole trouble is a manifestation of **anaphylaxis**.

The echinococcus poison may have dialyzed through the walls of the cyst, sensitizing the patient, or this result may have been accomplished by a preceding puncture. As he reviews the symptoms, the analogy with the symptoms of anaphylaxis in experiments on animals and in veterinary practice is striking. Dévé (Revue de chir., July, 1911).

In the last 70 cases of hydatid cyst treated by the writer and his associates, all were treated by simple **marsupialization**, together with the insertion of a **drainage-tube** into the cyst cavity for several days to maintain a sinus and insure healing from the bottom. There were but 7 deaths in the series, although 19 of the cysts were suppurating. Two of the deaths were in patients with suppurating cysts, 3 deaths in cases with ruptured cysts and general peritonitis, and the other deaths were in complicated cases.

Healing after this operation is complete in an average time of from three to six weeks. C. MacLaurin (Brit. Med. Jour., Jan. 10, 1914).

Free incision and drainage are being resorted to more frequently of late, and with results that justify such radical means.

Electrolysis and potassium iodide have been successful in a few cases.

Non-parasitic Cysts.

This form, according to Boyd (1913), occurs mainly in females and has been met with in infancy as well as in old age. The signs are abdominal swelling with fluctuation but of low tension, a characteristic of these cases. They progress rapidly if neglected, while the prognosis is not unfavorable if surgical treatment is promptly resorted to.

Treatment.—Surgical **removal** is indicated as soon as the condition is recognized, but simple **puncture**

should be **avoided** as it has often proved fatal.

In a review of the pathology of the reported cases of non-parasitic cysts of the liver, the principal clinical features of the solitary cyst were as follows: Eighty-six per cent. of the reported cases were in the female sex, which is in agreement with the suggested congenital origin, as developmental defects are more common among females than among males. The youngest case was 18 months old and the oldest 75 years, but in one instance the liver was known to be enlarged at birth. S. Boyd (Lancet, Apr. 5, 1913).

Miscellaneous Parasites.—The liver may contain the *Pentastomum denticulatum*, the larval form of *Linguatula tenioides*, the adult worm of which is lancet shaped, marked with numerous rings and commonly found in the nostrils. The *Coccidium oviforme* is common in the liver of the rabbit, forming whitish nodules and producing phenomena resembling those caused by malaria, besides tenderness over the liver, diarrhea, and nausea.

AMYLOID LIVER (Lardaceous Liver; Waxy Liver).—This condition is characterized by an infiltration of the liver by a so-called amyloid substance.

SYMPTOMS.—There are no characteristic symptoms of amyloid liver. The patient presents the symptoms of the primary disease to which the amyloid change is due. He is pale, cachectic, and later may be dropsical. There is no jaundice nor bile pigment in the urine. Bile is secreted and flows into the intestines, coloring the contents. There are disturbance of digestion and often diarrhea, on account of the amyloid deposit in the intestine. The urine is usually copious, pale, of low specific gravity,

and contains much albumin on account of the amyloid disease of the kidneys.

On physical examination the liver is found large, firm, smooth, and not tender. Its lower edge is usually rounded, but sometimes sharp, and not rarely as low as the iliac crest. There are no signs of portal obstruction. The spleen may be large, on account, chiefly, of the amyloid change in it.

The general condition grows gradually worse, the skin assumes an earthy pallor, which, some believe, is characteristic, and the patient dies from exhaustion, if not cut off by an intercurrent affection or a "terminal infection."

The duration of the disease is usually several years, although occasional cases run their course in a few months.

DIAGNOSIS.—This is usually easy from the associated conditions. The occurrence of progressive enlargement of the liver in a case of long-standing suppuration, especially of a tuberculous or syphilitic character, renders the diagnosis almost certain. The coexistence of degeneration of the kidneys, spleen, and intestines adds to the certainty of the diagnosis.

ETIOLOGY.—In amyloid liver a deposit of waxy material takes place in the blood-vessels and interstitial tissue of the liver. It occurs as part of a general degeneration in certain constitutional conditions, of which prolonged tuberculous suppurations of the bones, lungs, and urinary tract are the most frequent. Next to these, syphilitic suppurations are the most common causes; but the amyloid change may occur in syphilis without suppuration. It is also occa-

sionally found in rickets, Bright's disease, leukemia, malignant disease, and in protracted convalescence from infectious fevers.

MORBID ANATOMY.—In advanced stages the liver is greatly and uniformly enlarged. Its size may be doubled and its weight more than trebled. The surface is smooth, firm, and of a slightly glistening yellowish gray color. On section the surface has an anemic, waxy appearance, is semitranslucent in thin sections, and the infiltrated areas stain a rich mahogany-brown on the application of a dilute solution of iodine, while the normal parts become a light yellow.

The morbid change usually affects the capillaries in the middle zone of the hepatic lobules first, and later the interlobular vessels and connective tissue. In the capillaries "the amyloid substance lies between the endothelium and the liver cells, and the latter atrophy apparently because of the pressure which the amyloid substance exerts. Some of the cells show fatty and albuminous degeneration" (Thoma).

Similar changes are usually found in the spleen, kidneys, and mucous membranes of the intestines.

Amyloid disease of the liver is localized to the tiny blood-vessels at first, to the walls of the trabecular capillaries; later, of the intralobular capillaries. Amyloid matter forms a solid cylinder of the former arterial walls, with almost total obliteration of the lumen of the vessel. When the liver cells show changes, these begin near the affected capillaries. Thus it is that specimens may show three layers in a lobule—a narrow periphery of fatty degeneration, normal liver cells in the center, and between them the intermediate layer

showing the changes of amyloid degeneration. The cell granulations are gradually replaced by this material. Others claim that the hepatic cells never become amyloid, the changes found in them being due to mechanical forces alone. The author gives a detailed description of the histological findings in 2 cases of amyloid disease of the liver. His investigations show that amyloid degeneration is not seen in the liver cells at all, the changes there found being those of compression, deformity, and atrophy, always secondary and mechanical. B. Auclie (Jour. de méd. de Bordeaux, Sept. 15, 1901).

PROGNOSIS.—The prognosis is bad. Many, however, claim that a cure is possible in the initial stage if the cause is removed.

TREATMENT.—There is no effective remedy for the disease known; therefore the treatment should be prophylactic, *i.e.*, **removal of the cause.**

Tuberculous disease of bones should be treated surgically and cured as soon as possible, as should also chronic suppurations of all kinds. Syphilis should be vigorously treated. The patient should be nourished and the strength maintained as well as possible.

SYPHILIS OF THE LIVER.

Various morbid conditions may be caused by the specific agent of syphilis. Hepatic syphilis may be *inherited*, the organ becoming first enlarged and hardened, then reduced in size and lobular owing to the formation of connective tissue, or, rarely in inherited syphilis, be the seat of gumma. Or, it may be the result of *acquired* syphilis, as a tertiary manifestation, either in the form of interstitial hepatitis, gumma, amyloid disease or, rarely endarteritis.

Cases of syphiloma on the surface of the organ are, according to certain writers, rare. This does not accord with the writer's personal experience. With one or two exceptions the tumor has been attached to the left lobe of the liver. This is a point which should ever be borne in mind. J. M. Anders (Jour. Amer. Med. Assoc., June 22, 1912).

The gumma is the lesion most frequently observed. It may range in size from that of a pea to that of an orange, its favorite seat being the convexity of the organ close to the suspensory ligament, though at times found in the organ or the connective tissue of the vessels. Central cheesy degeneration and fibrosis then follow in turn with increasing impairment of function.

SYMPTOMS.—Though infrequent, jaundice may occur, owing to portal obstruction; it may be slight, moderate, or severe, but usually develops rapidly. Anorexia, nausea, bitter taste in the mouth, diarrhea, and pain in the epigastrium usually precede the icterus. Loss of weight is usual, and fever is commonly observed. As to the physical signs, general enlargement of the liver with nodules or large rounded masses are the most common, the left lobe being relatively much larger than the right as observed by McCrae. Ascites is sometimes observed.

The clinical statistics underestimate the frequency of syphilis of the liver. The Wassermann reaction will increase the number of cases. The symptom-complex of syphilis of the liver is not pathognomonic, as it simulates almost every hepatic disease; occasionally it simulates febrile diseases. Whenever the diagnosis is uncertain, resort should be had to the therapeutic test as well as to the Wassermann reaction. Frequently

mixed treatment has a striking effect on lues of the liver, regardless of the time it has existed. Schrager (Jour. Amer. Med. Assoc., Mar. 9, 1912).

Case which represents an important group of cases of hepatic syphilis, in which the disease resembles ordinary cirrhosis of the liver. The symptoms are usually those of pain in the right hypochondrium, with more or less gastric disturbances, occasional hematemesis, and ascites. Jaundice is rare in these cases of hepatic cirrhosis, and, according to Hale White, so also is ascites. On examination of the abdomen the liver and spleen are found to be enlarged and firm. Pain generally is a prominent symptom, owing to the perihepatitis and perisplenitis, and although in the case reported by the author there appears to have been a remarkable absence of this symptom, yet from the appearance *post mortem* of the liver and spleen, which were unduly adherent to the diaphragm, some pain almost certainly must have been present at one time or another. The diagnosis in these cases rests on the preponderance of syphilis over alcohol in the history, and the relief of symptoms by antisiphilitic treatment. Core (Lancet, Mar. 8, 1913).

TREATMENT.—While this cannot influence the results of the syphilitic process, cirrhosis, amyloid, etc., the causative condition demands the prompt use of **potassium iodide**, **mercurial inunctions**, or **salvarsan**. A very prompt favorable result may thus be obtained in some cases.

Years ago, in discussing continued fever of obscure origin, the writer reported a case of syphilis of the liver illustrating that feature. He recently saw another case in which he was able to help the patient by remembering his former experience. The patient was put on large doses of **potassium iodide**, the nocturnal pains stopped almost at once, the liver went down, but the tumor remained as a stony, hard mass in the same

region, showing about the same resistance to X-rays. In these cases the therapeutic test is advisable. George Dock (Jour. Amer. Med. Assoc., June 22, 1912).

The treatment is the usual therapy for syphilis, with especial emphasis placed on the administration of **potassium iodide**. In many of the cases this alone was given with a perfect result. No difference could be observed when **mercury** was added, but it seems wise to give both drugs. Almost immediate disappearance of the fever, reduction in the size of the liver and nodules, and rapid gain in the general state and weight occur when iodide alone is given. One patient gained 25 pounds in a month. **Salvarsan** was given to 3 patients, in doses of 0.5 or 0.6 Gm. ($7\frac{1}{2}$ or 10 grains), and in 2 of these mercury and iodide were not given in order that the effect could be watched. Improvement followed in both cases, but not so rapidly as was the case with iodide alone or mercury and iodide. Thomas McCrae (Jour. Amer. Med. Assoc., June 22, 1912).

Instance of successful **operative treatment** of gummatous tumor in the liver confirms the advantages of resecting the tumor in the liver after failure of medical means to relieve. Even if the patient is known to be a syphilitic, the liver process may be of malignant or parasitic nature, while gummatous tumors in the liver are not much influenced by even vigorous antisiphilitic drugging, and one can seldom be absolutely sure that the trouble is actually a syphilitic process, especially when, as in the case described, the patient strenuously denies venereal infection at any time. Frattin (Riforma Medica, Nov. 29, 1913).

TUBERCULOSIS OF THE LIVER.

The liver may be involved in the course of miliary tuberculosis or secondarily to tuberculosis of the lungs or intestines. Two cases of

primary hepatic tuberculosis have been reported. Although the organs may be crowded with tubercles, jaundice is only occasionally observed. The organ may be enlarged and lobular. Emaciation progresses rapidly and the temperature is that of general tuberculosis. The disease is somewhat more frequent in children than in adults.

In 2 personal cases much the same train of symptoms occurred, although the first was much more acute. In each there was marked jaundice. The temperature and general condition were obviously those of tuberculosis. The liver was particularly involved. In the first case the liver and spleen seemed to be the only two organs affected. In the second the disease was more widespread and much less acute, but in this case also the most extensive disease was jaundice of the liver and spleen. Milne (N. Y. Med. Jour., May 10, 1913).

Analysis of 34 cases of "conglomerate tubercle" the writer has compiled from the literature, and 13 of a tuberculous abscess in or near the liver. In 30 of the cases the tuberculous process was a necropsy discovery. In 23 there had been no signs during life of any abdominal trouble. An operation was undertaken in 15 cases, but on an erroneous diagnosis in all but 3 instances. As long as the process is in an incipient stage or restricted to the inside of the liver, the symptoms are merely those of gastrointestinal disturbance. Not until the process reaches the surface of the liver or spreads beyond it does its true nature become manifest. It may then appear as a tumor or there may be evidences of irritation of the peritoneum with perihepatic abscesses. Lotheissen (Beiträge z. klin. Chir., lxxxii, H. 5, 1913).

TREATMENT.—The treatment is that of the tuberculous process, with **open air, potassium iodide, and creosote carbonate** as sheet anchors.

The writer emphasizes the necessity for general treatment for the tuberculosis, including exposure to **direct sunlight**. Complete recovery may be anticipated if treatment is commenced early enough and the patient has the resisting powers of youth, and the operation is managed in such a way as not to make too much demands on his strength. The tumor should be removed after intrahepatic ligation of vessels. Wendel has reported the excellent outcome a year later after **resection** of 940 Gm. of liver tissue for an adenomatous growth. The cavity left must be **tamponed**. **Resection of ribs** may be necessary, and the writer found it advisable to resect only two or three at a time, thus fractioning the operation; in 1 case he thus removed separately 3 chesny foci, each nearly as large as a man's fist. Local anesthesia with primary ether **anesthesia** or the "twilight sleep" is ample for the **fractioned operation**. In 10 of the 15 operative cases the patients recovered although the tuberculous process was far advanced. The writer advises not to let the propitious hour for **operative treatment** slip past while trying antisyphilitic treatment. G. Lotheissen (Beiträge z. klin. Chir., Bd. lxxxii, H. 5, 1913).

FATTY LIVER.

Fatty liver occurs under two forms: *fatty infiltration* and *fatty degeneration*. The former represents a normal condition, since liver-cells always contain some minute globules of fat. In this form the particles of fat penetrate the liver cells, where they coalesce into growing droplets and push aside the cell protoplasm, and often destroy it by interfering with its nutrition.

In fatty degeneration there is a conversion of the protoplasm itself of the cell into fat, probably by the action of some toxic agents, such as phosphorus.

FATTY INFILTRATION.

SYMPTOMS.—There are no distinctive symptoms. The liver may, if large, be felt to be smooth, soft, not tender, and with rounded edges. There is no jaundice. Addison long ago drew attention to a semitransparent, pale, smooth, soft skin, feeling like softest satin, occurring in fatty liver. He considered it almost pathognomonic. And Hebra noticed a similar condition of skin in habitual spirit drinkers, and in them fatty liver is common.

DIAGNOSIS.—The fatty liver can usually be recognized by its soft, smooth character and its occurring in the obese or the emaciated. The large amyloid liver is distinguished by being firm, larger, and by the history of the cause and the evidence of renal disease.

ETIOLOGY.—The conditions under which fatty infiltration occurs may be divided into two main classes, strikingly in contrast with each other. In one class the fatty liver results from dietetic errors, from eating an oversupply of rich food, and as a part of general obesity, chiefly in persons of sedentary habits. The blood is overcharged with fat, of which much is stored in the hepatic cells.

The other class consists of cachectic cases, of which pulmonary phthisis furnishes the greater number. In these, on account of the low powers of oxidation, even the small amount of food that is taken is not properly oxidized and much of it is converted into fat and deposited in the liver cells.

MORBID ANATOMY.—The liver is large, smooth, and soft. It may weigh 10 or 12 pounds. The edge is

thick and rounded. The deposit of fat begins in the cells at the periphery of the lobule, and in time distends them. It can be extracted from the cell with ether, leaving the cell shrunk.

The specific gravity of the liver is reduced, so that the whole organ floats when placed in water.

PROGNOSIS.—This will depend on the cause. If the condition that leads to the deposit of fat in the liver is relieved the further deposit of fat will cease and the hepatic cells will gradually be restored to their normal condition.

TREATMENT.—Treatment should, therefore, be directed to **removal** of the **cause** of the condition. In the obese there should be a careful **regulation of diet**, with a view to lessening the formation of fat while sustaining the strength. Habits of **early rising** and active **exercise** should be encouraged, care being taken not to induce overfatigue, especially if the heart shows signs of weakness, as it often does from fatty infiltration or degeneration. **Water** should be **freely taken** on an empty stomach, and **occasional purging** resorted to. **Little**, if any, **alcoholic stimulants**, especially beer, should be **allowed**. If sufficient active exercise cannot be taken, **massage** and **resistance movements** will, to a great extent, supply its place.

In the anemic form of fatty liver, such as occurs in pulmonary phthisis, the treatment should aim at improving the general condition without regard to the liver.

FATTY DEGENERATION.

This results from poisoning of some form, as in acute yellow atrophy,

in which the liver changes are typical of fatty degeneration.

DISEASES OF THE GALL-BLADDER.

INFLAMMATION OF THE BILE PASSAGES AND GALL-BLADDER (ANGIOCHOLITIS OR CHOLANGITIS AND CHOLECYSTITIS).—Definition.—This is an inflammation of the biliary tract due in most instances to infection by pathogenic bacteria. It may affect the common bile-duct and all its branches or any part of them, the cystic duct, or the gall-bladder and may be acute and chronic.

A method of draining the bile ducts and gall-bladder has been suggested which has already given excellent results in the diagnosis, prevention, and treatment of biliary disease. In 1917 Meltzer formulated his conception of contrary innervation as applied to the filling and emptying of the gall-bladder; Oddi's sphincter at the lower end of the common bile duct and the musculature of the gall-bladder are supplied with inhibitory and motor fibers from the splanchnic and vagus nerves, which act antagonistically to each other, so that when the sphincter is relaxed the gall-bladder contracts, and *vice versa*. He also showed that the application of a solution of magnesium sulphate to the mucous membrane of the duodenum was followed by relaxation of Oddi's sphincter, a result which was not produced when the salt was taken by the mouth. His hint that this observation should be utilized in human disease has been acted on by *Lyon*, of Philadelphia, who believes that the application of magnesium sulphate of the duodenal mucosa induces contraction of the gall-bladder, and that incision of the gall-bladder or disease of its walls removes the normal antagonistic action of the gall-bladder and Oddi's sphincter, so that bile then runs continuously into the duodenum. The patient is examined 12 hours after a meal, contamination of the duodenal contents from the mouth and stomach being obvi-

ated by frequent washings. When the Einhorn tube has entered the duodenum, 75 c.c. of a 33 per cent. solution of magnesium sulphate is introduced, and the contents are then gently aspirated. In health the first bile thus obtained is of a light yellow-golden color, and comes from the common bile duct; after a short time the bile suddenly changes to a darker golden yellow, and becomes more viscid and larger in quantity; this bile is regarded as coming from the gall-bladder; later bile of a lemon color, thinner and more limpid than the other two, follows and is believed to be that freshly secreted by the liver.

The normal gall-bladder contains $1\frac{1}{2}$ to $2\frac{1}{2}$ ounces of bile, but in stasis or atony of the gall-bladder as much as 6 ounces may be obtained, provided, of course, that the cystic duct is patent.

The characters of the bile change as the result of biliary infections, and comparison of the 3 samples, which can be separated into different bottles, will indicate what part—the gall-bladder, or common bile duct—is infected or mainly involved. Chemical, microscopical, and bacteriological examination of the bile can thus provide an early diagnosis; according to Brown, early cholecystitis can be detected at a stage when the clinical manifestations—indigestion and minor colic—are vague and the gall-bladder does not show any thickening or color changes to the naked eye, so that bacteriological examination of the aspirated bile provides the surgeon with data he might fail to obtain from an exploratory laparotomy.

When more than $2\frac{1}{2}$ ounces of gall-bladder bile is obtained by aspiration, the diagnosis of stasis is justified, and by means of repeated aspirations this condition, which is of such importance in favoring infection and cholelithiasis, can be obviated.

In cholelithiasis the bile may convey a gritty feeling to the finger, and microscopically show clustered masses of precipitated bile salts or pigment; on one occasion small concretions were aspirated through the tube, and several times calculi too large to be recovered by the tube were passed by the bowel after aspiration. (Brit. Med. Jour., Jan. 8, 1921.)

Symptoms.—Since acute catarrhal cholangitis nearly always follows gastroenteric catarrh, the usual acute dyspeptic symptoms precede those due to the disease of the bile-ducts; such as anorexia, belching of gas, epigastric distension, nausea, vomiting, and constipation. These symptoms may, however, be very mild, or most of them may be absent, and jaundice be the first symptom noticed. The jaundice deepens rapidly, but is always of a bright-yellow tint, never the green or bronzed hue of that due to malignant disease.

In 20 per cent. of the writer's patients with acute cholecystitis there was a history of digestive disturbances, while 75 per cent. had had trouble with their gall-bladder. Pains were a prominent feature. There was vomiting in 31 per cent., generally with no connection with the meals. In some cases the symptoms suggested ileus. There was no fever in some, but as a rule the temperature ran up quite high and 22.5 per cent. had chills. The most characteristic sign is tenderness under the right costal arch. Paus (*Norsk. Mag. f. Lægevidenskaben*, Jan., 1917).

The stools are clay-colored and the urine contains bile pigment. The temperature may be slightly elevated. The pulse is usually normal, but may be slow, being only 40 or 50 to the minute. A dull, heavy, sleepy condition may be present. The liver is sometimes enlarged and palpable below the costal margin.

If the catarrhal inflammation is confined to the gall-bladder the cystic duct usually becomes obstructed by pressure of the bladder contents on the outlet. No jaundice occurs, or any of the foregoing symptoms, except a sense of pressure and sensitiveness at the seat of the gall-blad-

der. When distended, it may, if the abdominal wall is lax and not too thick, be felt as a pear-shaped mass adherent to the liver and moving with it. In suppurative cholangitis the symptoms are usually severe, but may be latent, especially if the disease occurs in the course of an acute infectious disease. They may suggest typhoid.

Gall-bladder inflammation, in the absence of lithiasis, may produce the same symptoms and signs as occur in cholelithiasis. Thus in typhoid cholecystitis there may be no history of typhoid fever, no record of any exposure to infection, and yet serious illness result. In many of these cases the Widal reaction may be negative, and the course of the illness can only be cleared up by operation and a bacteriological examination. A. E. Morison (*Brit. Med. Jour.*, Dec. 20, 1913).

There is, in most cases, a previous history of gall-stones. The patient usually suffers from irregularly recurring chills, with fever and sweating, the temperature rising to 104° F. or more. There is swelling and tenderness of the liver. Jaundice is always present, but more variable than in the catarrhal variety; it may be intense. Leucocytosis occurs and is suggestive of the condition. Later the case presents the appearance of a well-marked general pyemia with emaciation and weakness.

Referring to pericholecystitic adhesions after a study of 1000 reported and 20 of his own cases, the writer states that affections of the gall-bladder commonly represent progressing infections of the wall of the viscus, and that when the external coats are involved, the formation of pericholecystitic adhesions is a very common sequence. In 1000 instances of gall-bladder disease, proved surgically, 49 per cent. showed perichole-

cystitic adhesions, over 42 per cent. involving other viscera by extension. Pericholecystitic adhesions occurred nearly twice as often in cases without as those with stones. The commonest effect of the adhesions is to interfere with the emptying of the bladder contents. The emptying of the stomach or duodenum was also frequently disturbed by the extension of the adhesions and in such cases the major symptoms were referable to those viscera. Where the common or cystic ducts were partly obstructed by the adhesions there were colicky attacks; constipation was common where portions of the gut were constricted; nausea was fairly common; constant or intermittent jaundice occurred frequently, and a very large proportion of cases showed some abdominal tenderness. F. Smithies (Jour. Amer. Med. Assoc., Nov. 30, 1918).

In *chronic catarrhal angiocholitis* the symptoms may be very characteristic. The jaundice may vary if the degree of obstruction alters, as it often does when a gall-stone is situated in the diverticulum of Vater, where it may act as a "ball-valve," producing complete obstruction as it moves into the outlet of the duct, and, again, allowing bile to pass as it moves back into the diverticulum. In chronic angiocholitis there are often recurrent attacks of fever with chills and sweating, the so-called intermittent hepatic fever. Such cases may have a history extending through some years. It is probably to this class belong the cases regarded as suppurative cholangitis with a prolonged history and ultimately terminating in recovery.

Diagnosis.—In acute catarrhal cholangitis the diagnosis is usually easily made from the digestive disturbance and gradual onset of the jaundice. Gall-stones are excluded by the absence of colic and the fact that the

jaundice is not of sudden development. In catarrhal cholecystitis there is enlargement of the gall-bladder, which may be palpable as a pyriform tumor adherent to the liver and rising and falling with respiration. Not infrequently a tongue-like lobe of the liver is mistaken for a distended gall-bladder. So may also a movable kidney; it is usually more easily displaced, and is not attached to the liver. Instead of being smooth, rounded, and elastic, the distended gall-bladder may, from inflammatory thickening, appear more like a solid tumor and be mistaken for cancer in this situation, but cancer is usually associated with jaundice and cachexia. Echinococcic cysts have also to be excluded; aspiration may be necessary to do so. The history and shape of the tumor may be sufficient to differentiate between the two conditions.

The diagnosis of suppurative cholangitis is to be made by a history of gall-stones, the occurrence of a septic condition with enlargement and tenderness of the liver, and the existence of leucocytosis. There is progressive loss of flesh and strength. The duration rarely exceeds a few weeks, the cases lasting months and ultimately recovering being most probably cases of chronic catarrhal cholangitis due to obstruction, and causing intermittent hepatic fever.

There are numbers of dyspeptics whose symptoms are due to gall-bladder disease. Diagnosis should be made early and treatment instituted before the occurrence of gall-stones, if possible. Surgery is the only treatment for a certain class of cases. In all early cases, exclusive of those dangerously acute, medical treatment should be tried before recourse to

surgery. Verbrycke (Amer. Jour. Med. Sci., Apr., 1912).

The differential diagnosis of biliary calculi from right renal calculi is of great importance, and should be carefully made in every case presenting a stone in this region. The following points will aid in identification: 1. Biliary calculi show more distinctly and appear smaller when the plate is placed on the abdomen than when the plate is placed on the back. The opposite is true of renal calculi. 2. There is a ring-like shadow cast by a biliary calculus, when there is a calcareous coating to a cholesterol nucleus. Renal calculi seldom if ever have this appearance. 3. When three or more biliary calculi are present, they are likely to have faceted surfaces, which are readily recognized. One is usually larger than the others, and the group frequently has the appearance of a large, branching phosphatic calculus. 4. Moving the tube from side to side, alters the relation of a biliary calculus to the kidney, but it does not alter the relation of a renal calculus to the kidney. L. G. Cole (Surg., Gynec. and Obstet., Feb., 1914).

Etiology.—Inflammation of the bile-passages usually results from extension of an inflammatory process from the duodenum, and is, in the majority of cases, associated with gall-stones. The duodenal catarrh that precedes the cholangitis usually follows acute indigestion.

Motile organisms can and usually do reach the gall-bladder from the intestines by ascending the common and cystic ducts. Organisms rarely, if ever, reach the gall-bladder from the intestines by way of the portal vein. The tubercle bacillus and the ameba coli are probably exceptions to this. But these organisms produce an infection of the liver first, and an infection of the gall-bladder is secondary to the liver infection. Else (Surg., Gynec. and Obstet., Dec., 1909).

Cultures of the emulsified tissues of gall-bladders or adjacent lymph glands showed that streptococci were the chief micro-organisms associated with cholecystitis. The direct etiologic relationship of the streptococcus is established by their presence, often in numbers proportionate to the degree of gross and microscopic changes, by their having elective affinity for the gall-bladder of animals and by the specific agglutinating power of the serum of the patient from whom isolated. The elective affinity for the gall-bladder of animals of the strains from the tonsils indicates strongly that cholecystitis is commonly a blood borne infection from a focal source. R. O. Brown (Arch. of Intern. Med., Feb., 1919).

The young are most susceptible to it, but it may occur at any age. It occurs also as the result of exposure to cold, chills, malaria, typhoid fever, pneumonia, and in the course of Bright's disease, chronic heart disease, emphysema, etc. It may occur in the course of any organic disease of the liver, as inflammation, cancer, and hydatids.

There seems to be a definite causal association of cholecystitis and cholelithiasis with pregnancy. Symptoms due to either of these conditions may occur during pregnancy, during puerperium following labor at term, or after miscarriage. The existence of gall-bladder disease is not in itself a cause of miscarriage, but miscarriage may induce the development of active symptoms from a process previously latent. Gregg (Boston Med. and Surg. Jour., May 8, 1913).

Chronic catarrhal cholangitis may possibly be a sequel to the acute. It is always due to obstruction of the common bile-duct from gall-stones, stricture, pressure from without, etc. The obstruction may be complete, in which case the ducts are greatly dilated and filled with clear, watery

fluid similar to that of dropsy of the gall-bladder. If the obstruction is incomplete, there is less dilatation of the ducts, and, as some bile filters through, their contents are bile-stained and turbid. The gall-bladder is not much dilated in these cases, obstruction of the cystic duct being necessary to cause great dilatation of it. Gall-stones are usually found in it.

Suppurative cholangitis is usually associated with gall-stones, less frequently with echinococci and round worms. The mucosa, injured by such foreign bodies, becomes more susceptible to invasion by pyogenic organisms, and these are present normally in the intestines and in the lowest part of the common bile-duct.

Morbid Anatomy.—In acute catarrhal cholangitis the lower part of the common bile-duct is usually chiefly, and may be the only part, affected. The inflammation may extend to its larger branches. Post-mortem evidences are slight, as redness and swelling disappear after death. A plug of inspissated mucus may fill the diverticulum of Vater and completely obstruct the flow of bile. The gall-bladder, when affected, contains a more or less viscid mucous secretion; if there is obstruction of the cystic duct, the bladder becomes distended with fluid, of which it may contain 1 or more pints, usually thin and without bile. The walls of the gall-bladder are thin and shining; but, if the obstruction persist, they may become much thickened.

In suppurative angiocholitis the common duct becomes greatly dilated and its walls much thickened. Similar changes occur in the gall-bladder. Both are distended with pus. Ulceration may occur and per-

foration into the stomach, colon, or duodenum, or even into the urinary or respiratory tract. The intrahepatic bile-ducts may be distended with pus,—which is usually bile stained. The suppurative process may extend to the hepatic substance, resulting in abscess formation, or to the portal vein, and pylephlebitis result.

In 30 cases of biliary tract disease which came to operation there was a distinct enlargement of the liver in 26. In the remaining 4 there was definite evidence of previous or existing pathological change in the liver other than an enlargement. During the operation small pieces of liver tissue were removed for bacteriological and microscopical study. In cases of acute or subacute cholecystitis there was always found in the liver microscopical evidence of inflammation. The hepatic inflammation was characterized by leucocytic infiltration of the interlobular or periportal sheaths; in the more severe types of inflammation the infiltration at times involved also the parenchyma at the peripheries of the lobules and was associated with more or less edema, slight necrosis, and moderate fat infiltration. Cultures from both the liver tissue and from the bile in the gall-bladder usually revealed the same organism from each of the two different sources. In chronic cholecystitis the liver microscopically often presented a similar condition to that of an early case of cirrhosis. Evarts A. Graham (Surg., Gynec. and Obstet., May, 1918).

The bacteria present in these inflammatory processes are very various. The *Bacillus coli communis* probably plays the most important part, but staphylococci and streptococci are also common, as they are all present in the duodenum in health. The pneumococcus, staphylococcus, streptococcus, and the typhoid bacillus may be the active agents.

Treatment.—This consists in measures to relieve the gastroduodenal catarrh. Plenty of **liquids** should be taken, especially the **alkaline mineral waters**. The **bowels should be moved freely**, but not immoderately, by the use of **calomel** followed by **salines**, such as **Carlsbad salts**, **phosphate of soda**, etc. **Sodium bicarbonate**, with **bismuth**, may prove useful for the gastric disturbance. Such antiseptics as **resorcin**, **guaiacol carbonate**, and **bismuth salicylate** are useful.

A large **cold rectal enema** may be given daily; it is said to stimulate contraction of the gall-bladder and ducts and thus promote expulsion of the mucus that is obstructing the escape of bile. The water is to be retained so as to furnish more liquid for excretion, but it cannot effect that object better than water taken by the stomach.

Light liquid diet only should be given, as it is easy of digestion and less apt to ferment.

In catarrhal cholangitis, with and without the formation of concretions, the best results have been obtained from the following formula:—

R *Phenolphthalein*, gr. $\frac{1}{3}$ (0.02 Gm.).
Acid sodium
oleate gr. j (0.06 Gm.).
Salicylic acid,
 pure gr. iss (0.1 Gm.).
Menthol gr. j (0.06 Gm.).

Mix and make 1 pill.

Many cases ordinarily considered amenable only to surgical intervention can be satisfactorily treated at the patient's home by the use of the above. All foods known to be difficult of digestion and all **alcoholic beverages** are **interdicted**. One principal point to be carefully followed in the administration of this above pill is to insist that **large draughts of hot water** shall be taken with the pill, for the purpose of diluting the excretions and assisting in the break-

ing up of any concretions that may be present. C. G. Davis (*Therap. Gaz.*, July 15, 1907).

In the medical treatment of cholecystitis prophylaxis is most important, particularly in those infections of the gall-bladder complicating known diseases, such as typhoid. Early treatment of the diseased mucous membrane of the infected gall-bladder should be instituted before these infections cause obstruction of the cystic duct, calculi, or involve contiguous tissues. Urotropin (**hexamethylenamine**) and **menthol**, combined with **vaccine**, offer most promise, both for prophylaxis and active treatment. Engelbach (*Lancet-Clinic*, Feb. 3, 1912).

Treatment of simple catarrhal jaundice by repeated drainage of bile (see p. 424) and subsequent disinfection with **permanganate** or **silver nitrate** solution diminished the duration of the disease by one-half, and probably minimized the risk of sequels. This method is not only of use in the treatment of early inflammations of the gall-bladder and bile ducts, but may be valuable in infections persisting or recurring after operation. Further, there is wide scope for investigation on the lines thus opened up, on the action of cholagogues, the early stages of biliary stasis, functional liver disorders, and changes in the pancreatic juice. (Editorial, *Brit. Med. Jour.*, Jan. 8, 1921.)

Surgical treatment is indicated in suppurative cholangitis and cholecystitis, in acute attacks of gall-stone colic when prolonged several days or where perforation of the bladder or ducts is threatened, and also in chronic cholelithiasis. Delay under these conditions exposes the patient's life.

Cholecystitis is the beginning of all gall-stone disease and of most of the other inflammatory processes in the upper abdominal cavity. When properly treated it is curable either by dietetic and hygienic means or by

operative measures. **Cholecystostomy** seems to be adequate in most cases, but **cholecystectomy** must be performed when the gall-bladder is gangrenous, or when the duct is completely obstructed. Cholecystectomy should be performed as a secondary operation and several months after the primary cholecystostomy. Bayard Holmes (*Intern. Jour. Surg.*, Feb., 1910).

Immediate operative intervention is indicated wherever cholecystitis is initiated with high fever, chills, or signs of diffuse peritoneal irritation, as well as in cases where the symptoms, though milder, are progressive and the general condition does not soon improve. Statistics show that among 39 patients with acute cholecystitis alone, subjected to primary cholecystectomy from 1907 to 1910, only 1 died. Of 14 patients in whom there was angiocholitis in addition, 11 recovered after **cholecystectomy with drainage of the duct**, while 3 out of 4 succumbed after cholecystostomy. R. Leriche and G. Cotte (*Revue de chir.*, Dec., 1912).

The results of operation for cholecystitis are influenced by many conditions besides those in the gall-bladder itself. Among these are infections within the liver and bile-ducts which cause changes in the balance of the acidity of the stomach and of the alkalinity of the duodenum, the presence of pyloric spasm, and changes in the pancreas. Worthy of especial attention is a group of lymphatic glands extending along the common and hepatic ducts and on the cystic duct. Any case of cholecystitis with sufficient infection to produce symptoms would necessarily affect these glands. In the majority of cases, if these glands are much enlarged, one would find a lymphedema of the head of the pancreas as well as the infection of the gall-bladder. An exception is the general swelling of the mesenteric glands through malignancy or gross abdominal infection. The majority of cases of cholecystitis are undoubtedly best relieved

by **cholecystectomy**. C. H. Mayo (*N. Y. Med. Jour.*, Jan. 31, 1914).

In the presence of chronic pancreatitis without jaundice and without evidence of back pressure on the biliary tract the gall-bladder should be removed if it shows marked evidences of chronic cholecystitis, especially the strawberry type. In at least a half-dozen cases operated on in the Mayo clinic the following sequence has occurred: **Cholecystostomy** had been done for chronic cholecystitis without stones and with a complicating chronic pancreatitis. The patient was relieved for some weeks or months and then the symptoms returned. Recognizing the need of more **prolonged drainage** the gall-bladder was reopened and drained for a considerable period. There was complete relief so long as drainage of the gall-bladder continued, but sooner or later, after the fistula in the gall-bladder healed, the symptoms returned. It has been the writer's experience that removal of the gall-bladder promptly relieves the symptoms and permanently cures the patient. W. J. Mayo (*Amer. Jour. Med. Sci.*, Apr., 1914).

When the disease is located in the gall-bladder, **cholecystectomy** is preferred to **cholecystostomy**. This latter operation is used only in chronic pancreatitis or empyema, if the patient's condition does not warrant cholecystectomy. If the gall-bladder looks normal and empties easily it is not interfered with in the absence of other bile tract disease. Carcinoma in or about the bile tracts, as well as syphilis, can usually be diagnosed before operation.

The key to successful bile tract surgery is a good exposure. The cystic duct should always be clearly defined before division and ligation. The writer's incision, commencing high up in the angle between the ensiform and costal cartilages, proceeding to the middle of the rectus, then downward to the umbilicus and ending with an outward curve of several inches, is the incision of choice.

Bevan (Surg., Gyn. and Obstet., xxvii, 49, 1918).

ACUTE EMPYEMA OF THE GALL-BLADDER (ACUTE INFECTIOUS CHOLECYSTITIS; ACUTE PHLEGMONOUS CHOLECYSTITIS).—Symptoms.—

The onset is usually sudden, with pain in the right side of the abdomen in its upper part, but, as in appendicitis, the pain may be general over the abdomen. Nausea, vomiting; a rapid, feeble pulse; thoracic breathing, rise of temperature, prostration, distention, and tenderness of the abdomen are the chief symptoms. In the cases in which the disease is circumscribed, local tenderness soon becomes more marked. Jaundice is not usually present. Intestinal symptoms may be marked and not infrequently lead to a diagnosis of acute intestinal obstruction.

Diagnosis.—This is often impossible, especially in the fulminating cases. It is most often confounded with gangrenous appendicitis. In the less severe cases the signs of local disease—as pain, tenderness, signs of exudation, abdominal tension, etc.—may be sufficient to distinguish between the two diseases, unless the appendix is situated abnormally high.

Perforation of the stomach, the duodenum, the colon, the gall-bladder, etc., usually causes greater collapse at first and less marked septic symptoms later.

Etiology.—Acute empyema of the gall-bladder is a rare disease. Cases have been reported from time to time during the last few years. In about 75 per cent. of cases it is associated with gall-stones. It is doubtless due to infection by bacteria, which may

gain access by way of the blood or the bile. The typhoid bacillus, the colon bacillus, the pneumococcus, and the staphylococcus are the organisms most frequently present. Quite a large number of cases have followed typhoid fever, in some instances months after convalescence.

A comparison has been drawn between the causation of this disease and of appendicitis, the gall-bladder affection being of less frequent occurrence on account of its ampler blood-supply.

Morbid Anatomy.—The gall-bladder is distended, but not large, not containing more than a few ounces of mucus. There is a strong tendency to gangrene, proportioned to the virulence of the infection and the tension of the organ. The course is rapid, usually within four or five days. Adhesions are early formed to the intestines, omentum, etc. Later, perforation may occur and abscess result, or an abscess may form without perforation. In the severe cases general peritoneal infection is liable to occur. The contents of the gall-bladder may be very fetid.

Treatment.—Acute empyema of the gall-bladder is so rapidly fatal that only prompt measures are successful. As in phlegmonous appendicitis, so here **prompt surgical treatment** is necessary. The real difficulty is in making the diagnosis. In the early stage care should be taken not to obscure the symptoms by the undue use of opium. The temporary measures should consist in **absolute rest, hot applications, complete abstinence from food, water only** being given by the mouth, and **relief of symptoms** as far as possible until the necessity for operation is established, when the

gall-bladder, if there is empyema or gangrene of it, should be **incised** and **drained** or **removed**. In milder cases, in which the disease is localized, it is probably wiser to delay operation until the disease has been well circumscribed by the inflammatory process, when **incision** and **drainage** may be carried out and **gall-stones**, if present, **removed**.

TUMORS OF THE BILIARY TRACT.

CANCER.—Cancer may occur as a primary disease of the gall-bladder and of the bile-ducts or may be secondary to cancer of the liver, stomach, pancreas, or peritoneum.

Primary cancer of the gall-bladder affects females much oftener than males—in the ratio of 3 or 4 to 1. The bile-ducts are affected about equally in the two sexes. The disease occurs usually from 40 to 70, but occasional cases are met with in early life and at advanced age.

Gall-stones are present in practically all cases of cancer of the gall-bladder. The relationship between the two conditions is in dispute. Some regard the cancer as developing in the glands of the mucosa on account of the irritation by the calculi, while others look upon them as formed subsequently to the commencement of the cancer. The greater frequency of occurrence of gall-stones in females gives support to the view that their irritation frequently excites the development of cancer.

The disease usually begins at the fundus of the gall-bladder, and at either extremity of the common bile-duct.

CANCER OF THE BILE-DUCTS.

—**Symptoms.**—It rarely forms a

tumor that can be felt through the abdominal wall. The jaundice usually occurs early, and is intense and persistent. The stools are persistently clay colored. A fatal termination usually follows in three or four months, from cholemia. It may be the cause of cholangitis with intermittent hepatic fever or there may be suppurative cholangitis.

It is practically impossible to make a positive diagnosis without an exploratory operation. The persistent intense jaundice is suggestive, and may, in some cases, render the diagnosis extremely probable, especially in the absence of biliary colic. The most valuable diagnostic indication is *Courvoisier's sign*, i.e., enlargement of the gall-bladder with jaundice.

Morbid Anatomy.—The cancer usually develops in the circumference of the duct as an infiltration of the submucous tissue. The surface of the deposits may be smooth or ulcerated. They occur most frequently in the diverticulum of Vater and may extend to the duodenal papilla.

Cancer of the ductus choledochus occurs mostly beyond 55 years of age and twice as frequently in men as in women. The most frequent site is in the neighborhood of the papilla of Vater, and next at the junction of the cystic and the hepatic duct. The cancer is usually cylindrical celled, and in masses the size of a bean or hazelnut, and gives early metastasis, especially to the liver or pancreas. The lumen of the mouth of the duct is never occluded by the tumor, but persistent high-grade jaundice appears, probably due to spasm such as occurs in prostatic hypertrophy. The liver becomes affected by biliary cirrhosis and is much enlarged, rarely reduced in size, but there is seldom ascites or splenic enlargement. In some cases infection

from the intestine occurs with consequent cholangitis or liver abscess characterized by fever and chills. The prognosis is grave, death usually occurring in five to six months. In one case not operated in, the time elapsing between the appearance of the jaundice and death was four months, whereas in another case in which cholecystenterostomy was done it was twenty-one months. As to the treatment, in any case of long-standing grave icterus, **surgical treatment** is indicated whether Courvoisier's sign is present or not; if a common-duct stone is found, it can be removed, whereas if cancer is found, especially about the papilla of Vater, the radical operation can be proceeded with, or if the patient's condition does not permit, further operation may be delayed for a later sitting in a day or two. In early cases without metastasis good results are obtained by **excising the tumor area**, including the papilla of Vater, and performing a **cholecystenterostomy**; in inoperable cases **cholecystostomy** will prolong life on the average one-half year. Morian (Deut. Zeit. f. Chir., Bd. 98, Hft. 4-5, 1909).

CANCER OF THE GALL-BLADDER.—Symptoms.—

Not rarely the attention is first arrested by the accidental discovery of a smooth, firm, egg-shaped swelling below the costal margin. It is fixed to the liver and moves with it in respiration. There is usually a sense of discomfort and later often of irregular pain in the neighborhood of the mass. The pain is rarely persistent or severe, and may disappear altogether. It is usually worse at night and may extend around to the back. Later, as the tumor enlarges, it becomes less defined, and nodules often appear on its surface. If dissemination has occurred, nodules may be felt on the liver and in the peritoneum. Ascites may result from the peritoneal affec-

tion or from pressure by diseased lymph-glands on the portal vein in the hilum of the liver. Jaundice occurs in probably not more than half of the cases; when it occurs it is a late symptom and depends on pressure on the bile-ducts in the hilum.

There is usually early general failure of health. In the later stages there is marked cachexia, and loss of flesh and strength, with, not infrequently, mental weakness and a prolonged period of subdelirium. Adhesions to the intestines may give rise to symptoms of partial or complete obstruction. Blood-stools may also occur.

The course is usually rapid, death occurring in a few months after the appearance of the tumor.

The writer calls attention to the frequency with which cancer of the gall-bladder and ducts has occurred in his practice, and quotes several others who have had the same experience. Out of 25 personal cases of disease of the gall-bladder and ducts which have come to operation, there have been 4 cases of carcinoma and 2 more suspected, which makes a high percentage.

Cancer of the ducts is usually accompanied or preceded by gall-stone history. The prognosis is bad, the spread being nearly always to the liver. The diagnosis is almost impossible without operation and sections of the gall-bladder or ducts for microscopic examination. J. Garland Sherrill (Annals of Surg., Dec., 1906).

Diagnosis.—The presence of a tumor and the progressive character of the local and general symptoms of the disease usually suffice for a diagnosis. In the absence of a tumor the diagnosis is difficult and may be impossible, as it may be also to distinguish a tumor formed by matted intestine from local peritonitis from a

tumor of the gall-bladder. Even incision and exploration not rarely fail to clear up the difficulty.

Tumors of the pylorus, of the transverse colon, of the kidney, and of the suprarenal gland may simulate tumor of the gall-bladder.

In view of the frequency with which unsuspected abnormalities of the gall-bladder are found at autopsy and upon laparotomy, there is evidently something wrong with present methods of physical examination of this organ. The writer has found, indeed, on many occasions, that where no sign of gall-bladder trouble can be elicited upon examination of the patient in the recumbent posture, characteristic gall-bladder tenderness is noted upon deep pressure at the appropriate point when the patient assumes the standing position. Apparently the gall-bladder recedes above the costal margin during recumbency. L. Plantier (*Paris méd.*, May 24, 1913).

Morbid Anatomy.—The cancer may begin at the fundus or near the cystic duct, but often the walls of the gall-bladder are found uniformly thickened. The diseased gall-bladder may form a large, smooth or nodular mass adherent to the liver and to the intestines, and in the center of the mass a considerable cavity filled with opaque gray fluid containing much flocculent material and several gall-stones. The cancer is usually a cylindrical epithelioma, but it varies much. It may extend into the liver directly or by way of the portal fissure, where it may affect the portal vein and give rise to multiple deposits in the liver. The lymph-glands in the hilum of the liver are usually affected.

The statistics of Riedel (52 cases of carcinoma in 650 gall-bladder operations) and Petersen (34 cases of carcinoma in 168 gall-bladder operations)

illustrate the frequency with which carcinoma of the gall-bladder occurs. It is unquestionably true that many of these cases of carcinoma are instituted as a result of chronic irritation caused by cholelithiasis. The epithelium of a chronically inflamed gall-bladder very often undergoes a typical proliferation in the depths, and assumes a papilliferous form on the surface. It is not essential, however, that the gall-bladder itself should be the seat of a stone, in order for a papilliferous tumor to develop. A stone in the common duct, causing a damming up of bile and mucus in the gall-bladder, is as potent a factor in causing gall-bladder irritation as is a stone in the bladder itself. This fact is explained on the basis that, in addition to the mechanical irritation caused by a stone, there are other irritative influences, such as those caused by the presence of bacteria or of bile of altered consistency or chemical character. F. Pels-Leusden (*Archiv f. klin. Chir.*, Bd. lxxx, H. 1, 1906).

Treatment.—Symptomatic treatment is usually all that can be carried out. If the disease is recognized early before it has affected neighboring structures **cholecystectomy** may be practicable. Mayo Robson reports such a case in which he removed a large portion of the right lobe of the liver with the gall-bladder. The patient made a good recovery. Other similar cases have been lately reported.

Gall-stones are the most important etiological factors in malignant disease of the gall-bladder; the writer advises early operation, other things being equal, on active gall-stones, as nearly all the mortality-giving complications are the result of delay. Out of 250 uncomplicated gall-stone operations, the mortality was less than 1 per cent. Primary cancer, as a rule, gives a hard tumor in the region of the gall-bladder, which is tender

to touch, and, unless there is a peritoneal involvement, rigidity of the overlying muscle is not marked. It has been stated that at least one-half of the cases of jaundice diagnosed as due to gall-stones are caused by cancer or complicated with it. William J. Mayo (*Medical News*, Dec. 13, 1902).

Fatalities are more frequent than generally supposed after a simple exploratory laparotomy for chronic jaundice with cancer. In 31 cases in which **cholecystostomy** was done, 9 of the patients survived, the others succumbing to hemorrhage before the eighteenth day. The survivals were only for a few weeks up to six months. The addition of the cancer toxin to the toxic products which should have been eliminated by the liver and kidney renders the organism more susceptible to the action of the anesthetic. Chloroform, besides, has a direct hemolytic action. It may be advisable to make a preliminary injection of **calcium chloride** or of **serum**, as Weil suggests, to ward off this tendency to secondary hemorrhage. Quénu (*Revue de chir.*, March, 1909).

The only way to be sure to escape gall-bladder cancer is to have the bladder removed with its stones, but unfortunately the majority of cancers develop with stones in the latent stage. But for those persons who are aware of the presence of their stones he proposes the harmless operation done to insure them against danger. The patients generally reply, however, that the chances are so small they will take them rather than undergo the operation. And yet this prophylaxis seems to be the only weapon against cancer of the gall-bladder. The patients kill two birds with one stone by permitting the operation; they not only ward off all danger of cancer from this source, but they get rid of the annoying gall-stone trouble. With a positive diagnosis of cancer of the gall-bladder the writer does not attempt now to operate, believing

that the disease is whipped up possibly by the extensive operation necessary, while the lack of benefit deters other patients with non-malignant troubles from the surgical interference which would bring such blessings in their cases. B. Riedel (*Münch. med. Woch.*, June 20, 1911).

OTHER TUMORS OF THE BILE-DUCTS are rare. Fibromata have been met with. Adenomata occur occasionally. I met with one of the diverticulum of the common duct in a man aged 50 years. A gradually increasing jaundice was the first symptom. Later suppurative cholangitis occurred, with chills, high fever, and tender liver. At the autopsy the mass in the duct was found to act like a ball-valve, obstructing the discharge of bile.

To the idiopathic cysts of the common bile-duct which have been recorded, the writer adds another, which, as with the others, with one exception, terminated fatally. The unfavorable prognosis is due chiefly to the difficulty of recognizing this condition or at least not until a time when surgical intervention is hopeless. In his case it seemed probable that the patient, a child, was suffering from a cyst of the liver. A laparotomy revealed a large cyst in the region of the gall-bladder, which was incised, and another further up. Exploration was impossible owing to the collapse of the patient. Death resulted six days later, and at the autopsy it was found that the choledochus was greatly dilated from its upper to its lower end. Schloessmann (*Deut. Zeit. f. Chir.*, Bd. cix, Hft. 1-2, 1911).

ALEXANDER MCPHEDRAN,
Toronto.

LIVER, GALL-BLADDER, AND BILE-DUCTS, SURGERY OF. See ABDOMEN, SURGERY OF, and ABDOMINAL INJURIES.

LOBELIA.—Lobelia consists of the dried leaves and tops of the *Lobelia inflata*, or Indian tobacco, a weed indigenous to the United States, collected after a portion of the capsules have become inflated. The plant is a small herb, with alternate leaves; an erect, hairy stem, and blue flowers in the axils of the leaves. It has a slightly irritating odor and a burning, tobacco-like taste. It contains a liquid alkaloid, *lobeline*, and an acid, *lobelic acid*; gum resin, fixed oil, lignin, salts, chlorophyll, and a volatile oil.

PREPARATIONS AND DOSE.—*Lobelia*, U. S. P. (lobelia). Dose, 1 to 10 grains (0.065 to 0.65 Gm.); official average dose, $2\frac{1}{2}$ grains (0.15 Gm.).

Fluidextractum lobeliæ, U. S. P. (fluid-extract of lobelia), is a 100 per cent. preparation. Dose, 1 to 10 minims (0.06 to 0.6 c.c.).

Tinctura lobeliæ, U. S. P. (tincture of lobelia), is a 10 per cent. preparation. Dose, 10 to 20 minims (0.6 to 1.2 c.c.).

PHYSIOLOGICAL ACTION.—Lobeline, the active alkaloid of lobelia, exerts almost precisely the same effects as nicotine, the alkaloid of tobacco. Lobelia causes a brief primary stimulation of the motor centers in the spinal cord and medulla, in the latter acting especially upon the respiratory and vomiting centers. This stimulation is soon followed by depression, and with large doses paralysis.

A relatively important feature of the physiological action of the drug is that in the secondary depressive stage the motor nerve-endings in involuntary muscles are also involved, and, in particular, the endings of the vagus in the bronchi. This last effect is especially perceptible where the bronchioles are abnormally constricted (as in bronchial asthma) at the time when the drug is administered, and at present affords the chief therapeutic use of lobelia. The drug also tends to increase the secretions of the respiratory mucous membranes.

Upon the circulation lobelia likewise resembles nicotine in its action. It tends to paralyze the cardiac branches of the vagi (Dresser), and small doses taken continuously tend to cause a persistent increase in the pulse rate (Sollmann).

POISONING.—The symptoms of poisoning by lobelia or its alkaloid are much the same as those of tobacco poisoning. Nausea, giddiness, faintness, trembling of the limbs, cold sweats, frequent and prolonged vomiting accompanied by intense prostration, violent abdominal and esophageal pains, with occasional purging, are the chief features. The pulse, at first weak, becomes almost imperceptible; the breathing, shallow and difficult. The vision is affected. Stupor is followed by coma or convulsions, more or less widespread paralysis, collapse, and death by paralysis of respiration. Vomiting is occasionally absent; the constitutional symptoms are then accentuated, and death is apt to follow. One dram of the powdered leaves has proved fatal in about thirty-six hours. On post-mortem examination the brain was found congested and the gastric mucous membrane inflamed.

Treatment of Lobelia Poisoning.—This consists in washing out the stomach by **siphonage**. Solutions of **tannic** or **gallic acid** may be given, followed by hypodermic injections of stimulants, such as **ether**, **ammonia**, **strychnine**, and **digitalis**. **Saline hypodermoclysis**, with or without the addition of **epinephrin**, may also be availed of. The **recumbent position** should be maintained, and **heat** applied to the extremities. **Opium** given in full doses will relieve the pain, and later, in moderate doses, control the vomiting.

THERAPEUTICS.—Lobelia is chiefly used for the relief of **asthma** of the **bronchial** or **gastric form**. If the asthma is due to, or associated with, cardiac disease, lobelia should not be used. The drug should be taken in doses of $\frac{1}{2}$ to 1 fluidram (2 to 4 c.c.) of the tincture at the beginning of the attack, or in 10-drop doses every quarter of an hour until nausea appears or relief is obtained. It is a frequent constituent of unofficial asthma powders or cigarettes, to be burned or smoked during the asthmatic attacks. A feeble heart contraindicates its use.

Children are more tolerant of lobelia than adults.

Other spasmodic affections have been treated with lobelia,—**pertussis**, **spasmodic croup**, **chorea**, **epilepsy**, **infantile convulsions**, and **tetanus**,—but in many in-

stances other remedies, equally efficacious and less dangerous, are to be preferred.

In **bronchitic cough** with scanty expectoration and **bronchial spasms** lobelia is sometimes useful as a depressing expectorant.

Habitual constipation due to intestinal atony and deficient secretion is often relieved by 10-minim (0.6 c.c.) doses of the tincture of lobelia, given at bedtime. The efficacy of the drug is enhanced by combining with it cascara sagrada (*Rhamnus purshiana*).

By some lobelia has been used for overcoming **rigidity of the os uteri** during labor.

Lobelia in an infusion (1 ounce to the pint) is considered useful as a lotion in the treatment of the **dermatitis** due to poison ivy (*Rhus toxicodendron*).

Lobelia should not be employed as an emetic, as it produces too much nausea and depression. It has caused death when thus used.

W. and S.

LOCAL ANÆSTHESIA. See VARIOUS ANÆSTHETICS.

LOCOMOTOR ATAXIA. See TABES DORSALIS.

LUDWIG'S ANGINA. See PHARYNX AND TONSILS, DISEASES OF.

LUMBAR PUNCTURE.—This operation was originally proposed by Quincke for the withdrawal of cerebrospinal fluid from the spinal canal, and is used for diagnostic and therapeutic purposes. Its diagnostic uses are to estimate the pressure of the cerebrospinal fluid and also to determine its characteristics and composition by subsequent physical, chemical, microscopical, and bacteriological examination. Its therapeutic uses are as a decompressive agent in meningitis, hydrocephalus, intracranial tumors, cerebral abscess, uremia, etc., for the purpose of administering antitoxic sera in tetanus and cerebrospinal meningitis and for the purpose of inducing spinal anesthesia. Temporary diminution of intracranial and intraspinal pressure may be obtained in the diseases mentioned by the withdrawal of small amounts of fluid from the spinal canal,

because the spaces in the brain and that of the spinal column are continuous. In cerebrospinal meningitis this operation does good not only by relieving the pressure upon the cord and the cerebral centers, but the withdrawal of pus diminishes the toxicity of the spinal fluid. Its chief therapeutic use is in the administration of antitoxic sera and the production of spinal anesthesia.

ANATOMY.—The spinous processes in the lumbar region of the vertebral column do not project downward as much as in the other parts and a distinct space, about $\frac{7}{8}$ inch (22 mm.), exists in the transverse and $\frac{3}{4}$ inch (15 mm.) in the vertical diameter between the vertebral arches, which is filled with ligaments which will allow the passage of a needle. The lower limit of the spinal cord is the second lumbar vertebra. A puncture may be made below that point, under rigid asepsis, with slight risk.

INSTRUMENTS REQUIRED.—A special stylet needle, $3\frac{1}{2}$ inches (9 cm.) long and $\frac{1}{25}$ inch (1 mm.) in diameter, with point short and ground almost squarely across, a scalpel, a sterilized graduated test-tube, culture tubes, an ordinary hydrometer, and if the cerebrospinal pressure is desired a small mercurial manometer.

LOCATION OF PUNCTURE.—The puncture is usually made between the third and fourth or between the fourth and fifth lumbar vertebrae, but may for diagnostic purposes be made between the fifth lumbar and the first sacral. The needle is inserted at a point just below the tip of the spinous process and $\frac{1}{2}$ inch (1 cm.) from the median line. In children the needle may be inserted in the median line. The spinous process may be located by counting down from the seventh cervical vertebra, or by passing a transverse line between the highest points of the iliac crests, the patient standing, which will mark the tip of the spinous process of the fourth lumbar vertebra. The patient may sit in a chair or lie on his left side; in either case the body must be bent forward in an arch, knees drawn up, and shoulders forward. The site of the puncture and the opera-

tor's hands must be sterilized, and the needle boiled. Local anesthesia with a 0.2 per cent. cocaine solution or by ethyl chloride spray will suffice in adults; in children general anesthesia may be necessary.

TECHNIQUE.—A puncture through the skin is made with a scalpel at the chosen spot, to avoid infection. With the operator's left thumb or index finger between the two spinous processes as a guide, the needle is inserted on the level of the finger about $\frac{1}{2}$ inch (1 cm.) from the median line, in an upward and inward direction. In an adult it will enter the spinal canal at a depth of from $2\frac{1}{2}$ to 3 inches (6 to 7.5 cm.); in a child at from $\frac{3}{4}$ to $1\frac{1}{2}$ inches (2 to 4 cm.). If bone is encountered, slightly withdraw the needle and then reinsert it in a slightly different direction.

When the canal is entered, withdraw the stylet, and collect the fluid, as it drops from the needle, in a sterile test-tube. Discard the first few drops, if they are blood-stained. Not more than $\frac{1}{2}$ ounce (15 c.c.) of fluid should be withdrawn in case of an adult, not more than $1\frac{1}{4}$ drams (5 c.c.) in case of a child; except when puncture is made to relieve intracranial pressure, when from 1 to $1\frac{1}{2}$ ounces (30 to 45 c.c.) may be removed if necessary.

ADMINISTRATION OF SERA.—For this purpose a syringe with a capacity of at least 1 ounce (30 c.c.) is required in addition to the other instruments mentioned. The puncture is made and cerebrospinal fluid equal to the amount of serum to be injected is withdrawn; the serum is then warmed and slowly injected through the needle employed for the puncture.

In tetanus from $2\frac{3}{4}$ to $5\frac{1}{2}$ drams (10 to 20 c.c.) of antitetanic serum are injected into the cauda equina, the fibers of which are purposely wounded, into the nerves of the brachial plexus, if the infected site is upon the upper extremity and subcutaneously in the neighborhood of the wound.

In cerebrospinal meningitis from 1 to $1\frac{1}{2}$ ounces (30 to 45 c.c.) of serum are injected into the third or fourth lumbar space, after a like amount of cerebro-

spinal fluid has been withdrawn. These injections are repeated, at intervals of from twelve to twenty-four hours, for three or four days. Return of symptoms demands a renewed course of injections. Koplik substitutes for the syringe a glass funnel having a capacity of $5\frac{1}{2}$ drams (20 c.c.) attached to the needle by rubber tubing. W.

LUMINAL.—Luminal (phenylethylbarbituric acid) differs, chemically, from veronal (diethylbarbituric acid) in that one ethyl group is replaced by one phenyl group. It occurs as a white, odorless, slightly bitter powder, soluble in ether, alcohol, chloroform, and in alkaline solutions, slightly soluble in hot and almost insoluble in cold water. The dose of luminal, which is not official, is from $1\frac{1}{2}$ to 3 grains (0.09 to 0.2 Gm.).

Luminal-sodium (sodium phenylethylbarbiturate), the monosodium salt of luminal, occurs as a white, crystalline, hygroscopic powder, readily soluble in water, and may be given hypodermically, in the form of a 20 per cent. solution in boiled and cooled distilled water, in doses of from $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.).

PHYSIOLOGICAL ACTION.—Luminal in moderate doses is an hypnotic. In toxic doses it has a sedative action on respiration. Death occurs by respiratory paralysis. It is eliminated by the kidneys, although a small portion is probably decomposed in the organism. No injury to the kidneys or stomach has been observed. The hypnotic and fatal doses are closer together than with most other hypnotics.

THERAPEUTICS.—Luminal is employed as an hypnotic in nervous **insomnia** and in conditions of **nervous excitement**. It has been extensively used of late in **epilepsy**, in which a dose of $1\frac{1}{2}$ grains (0.09 Gm.) taken with a warm drink on retiring has been found very helpful to prevent seizures. (See Epilepsy, treatment of.) W.

LUNGS, DISEASES OF THE.—The more important diseases of the lungs—bronchopneumonia, croupous pneumonia, asthma, etc.—are treated in full under their respective headings.

PULMONARY CONGESTION.

Congestion of the lungs typifies the hyperemia observed elsewhere in the organism, and may, therefore, be divided into two classes: active and passive.

ACTIVE CONGESTION OF THE LUNGS.

SYMPTOMS.—The symptoms vary with the intensity of the congestion and the amount of lung-tissue involved. Dyspnea, cough, frothy expectoration, localized pain, wheezing, and accelerated breathing, owing to diminution of the caliber of the air-cells and deficient oxygenation, are usually observed; occasionally the expectoration is tinged with blood. In rare cases there is active pulmonary hemorrhage, followed by death. All these symptoms may be observed in pulmonary congestion of malarial and gouty origin. Death may also occur as the result of asphyxia, brought on by the mechanical blocking of the tubes by excess of secretion. The temperature rarely surpasses 100° F., and the pulse is tense and bounding. In favorable cases deferescence usually begins twenty-four to thirty-six hours after the onset of the active symptoms.

Both lungs are usually involved, and in mild cases the hyperemia gives rise to appreciable signs only at the base. Fine fremitus may be detected on palpation; the breath-sounds are bronchovesicular and unusually audible, the expiration being prolonged and harsh. Moist, subcrepitant râles attend the more severe cases, but these are also most evident toward the bases.

ETIOLOGY AND PATHOLOGY.

—Active congestion may occur as a

primary disorder, especially in persons in whom the kidneys are diseased. Exposure to damp and cold air while the surface is warm, as is the case during bicycle-riding, or prolonged bathing in cold water may under these conditions bring on pulmonary hyperemia, which in rare cases assumes a grave form. In the vast majority of cases, however, active pulmonary congestion is due—not to speak of the conditions such as pneumonia, pleurisy, bronchitis, etc., of which it forms an early stage—to the inhalation of steam, hot air, and other irritating factors. It has also followed violent emotions or fright. In the latter case paresis of the vasomotors is probably the most important pathological feature.

Congestion of the bronchial mucous membrane and the alveolar walls, and the presence of bloody and frothy mucus on section, constitute about all the morbid conditions found *post mortem*. The alveolar epithelium is sometimes found granular and swollen.

TREATMENT.—In cases due to exposure **dry cups**, **mustard foot-baths**, and **opium** internally, followed by a **saline purgative**, usually suffice to overcome the hyperemia when it is not severe. In cases brought on by local irritants—steam, hot air, acid fumes, etc.—the **bromides** in large doses are very effective. When the dyspnea is severe, however, **venesection** is indicated, especially if the patient be large and plethoric: a class of individuals in which active congestion is apt to occur. **Wet cups** should be used if venesection cannot be resorted to. **Tincture of veratrum viride** or of **aconite** in small, but frequently repeated doses, and closely

watched, will then prove effective in maintaining the pulmonary circulation at its normal level. **Nitroglycerin**, by dilating the vascular tree, tends greatly to relieve the pulmonary congestion. **Morphine** is of great value to relieve the dyspnea and pain. When there is any doubt as to the possible presence of pneumonia, **creosote carbonate**, in 5-minim (0.3 Gm.) doses, in capsules, should be given every three hours.

PASSIVE CONGESTION OF THE LUNGS.

The passive form is generally due to cardiac diseases, especially those in which the mitral and tricuspid valves are involved, and when dilatation and fatty degeneration are present. It may also occur as a complication of cerebral lesions and as a result of asphyxia. Tumors may also give rise to passive congestion by pressing upon a large venous trunk. Briefly, it may be caused by any condition capable of damming back the blood in the lungs.

SYMPTOMS.—The symptoms of this condition do not vary greatly from those of active congestion, but they do not appear suddenly, the progress of the pulmonary disorder depending upon that of the causative affection. In heart disease, for instance, the dyspnea only appears when compensation begins to fail. In pulmonary tumor active symptoms only occur when the pressure of the neoplasm is sufficient to cause a degree of vascular stenosis for which collateral circulation cannot compensate. Cough and the expectoration of frothy and blood-stained serum, which upon examination is found to contain pigmented alveolar epithelial

cells, constitute the characteristic signs of this form of hyperemia.

ETIOLOGY AND PATHOLOGY.

—The congestion being due to mechanical impediment to the flow of blood through the vessels, the latter are distended and the whole lung is enlarged. The vascular engorgement, the blood being dark and venous, causes the pulmonary tissue to become erect, firm, and resisting. When cut, it appears reddish brown; hence the name "*broken induration*" often given to this condition. There is marked increase of the connective-tissue elements and distention of the smaller vessels and alveolar capillaries, edema being commonly present. The alveolar walls are filled with cells containing altered blood-pigment, while their cavity contains epithelial cells in various stages of metamorphosis.

The morbid process starts at the base and gradually extends upward until, in some instances, the entire lung is involved.

TREATMENT.—The treatment is obviously that of the causative disorder: a **change of posture** from dorsal to lateral or even ventral sometimes affords relief temporarily. If possible, the patient should **avoid the recumbent position**, and the condition may be greatly improved by **free venesection**.

When bleeding cannot be resorted to, **veratrum viride**, 5 minims (0.3 c.c.) every ten minutes until the pulse softens, then every hour, is sometimes very effective by causing dilatation of the vessels of the splanchnic area. In desperate cases **aspiration of the right auricle** may be tried when blood cannot be obtained from the arm.

HYPOSTATIC CONGESTION.

This is a form of passive congestion in which the blood accumulates in the posterior and inferior portion of one or both lungs, as a result of great prostration and debility.

SYMPTOMS.—As noted by Piorry, hypostatic congestion may be suspected when old and debilitated patients, contrary to their custom, sleep with opened mouth. This suspicion becomes confirmed when slight cyanosis indicates that proper oxygenation of the blood is not taking place. Edema of the lower extremities is observed late in the history of the disease. In a large proportion of the cases, however, these characteristic symptoms are not detectable, and the diagnosis has to be based upon the physical symptoms. Slight dullness at the base of the lungs, feebleness of the respiratory murmur, and moist râles are the most marked of these, and suggest the presence of hypostatic congestion when other active symptoms attending inflammatory disorders of the lung are not present.

ETIOLOGY AND PATHOLOGY.—This form of congestion is generally observed in elderly people who are obliged, through disease, to remain a long while in the dorsal position. The shoulders being raised by the pillows, the blood normally accumulates in the bases. Chronic diseases, long-continued fevers, and cardiac disease attended by weakness of the heart-muscle may thus favor the development of the disease. Fractured limbs in the aged may also prove indirectly causative if the patient is allowed to remain in bed beyond a certain time. The lesions resemble those of a mild lobular

pneumonia. The capillaries are enlarged, the air-cells more or less collapsed, and the lung-tissue is dark red, dense, and engorged with blood and serum: a condition which has been termed "splenization."

TREATMENT.—The prevention of hypostatic congestion should be an important feature of the measures adopted in cases of paralysis, protracted tuberculosis, cancer, fracture, typhoid fever, etc., especially when these occur in old subjects. The **posture** should be **frequently changed** not only from side to side, but also in respect to the elevation of the shoulders. The **semiprone position**—the patient lying with one side of his abdomen touching the bed—is a useful one to prevent or relieve the local engorgement, but he should be allowed to **leave his bed as soon as at all practicable**.

It is important to sustain cardiac action; this may best be done by means of **strychnine, nitroglycerin, caffeine, digitalis, or pituitary gland**. Two grains (0.13 Gm.) of the latter with $\frac{1}{40}$ grain (0.0016 Gm.) of strychnine every four hours are valuable in such cases.

PULMONARY ABSCESS.

Although abscess of the lung is almost always associated with pulmonary tuberculosis and rarely with lobar pneumonia, it may also be the result of other local or neighboring pathological processes and injuries.

Mechanical injuries, such as fractured ribs and penetrating wounds, may cause abscess of the lung, especially in cases in which the vitality and, therefore, resistance to bacterial growth are below normal. Gangrene as a complication of pulmonary ab-

cess has been considered under CHEST, INJURIES OF, in the third volume.

SYMPTOMS AND DIAGNOSIS.

—When, in the course of pyemia or any other infectious disease in which the lungs are not primarily involved, localized distress in one or both lungs, shortness of breath, etc., and a rise in temperature appear, abscess of the lung is a possibility. It can only be verified, however, by the presence of pus in the sputa. These are usually yellowish green and emit an offensive odor, though less so than in gangrene or putrid bronchitis. At times they assume a reddish or brownish tinge and contain shreds of tissue which, microscopically examined, often prove to be elastic fibers. Blood-corpuscles, alveolar epithelium, crystals of margaric acid, cholesterol, mold-fungi, and various bacteria, according to the causative malady, may also be found in the secretions. Chills and suppurative fever are often present. There is a leucocytosis.

In abscess occurring as complication of acute pneumonia there is an intermittent rise in the temperature, usually about the time of the crisis, and marked prostration appears. At first physical examination affords but little information, though the signs of consolidation persist. When an abscess of large size opens into the bronchi, however, the signs of a cavity as witnessed in tuberculosis present themselves. The history of the case and the presence of the cavity afford opportunity for a certain diagnosis.

The history of the case aids in establishing the diagnosis. A previous pneumonia or septicopyemia would be strongly corroborative.

Tuberculosis is differentiated by its history, the smaller amount of pus in the sputum, and the usual sputum tests.

ETIOLOGY.—Acute pneumonia (lobar and lobular) is the disease in the course of which pulmonary abscess most frequently occurs next to pulmonary tuberculosis, but, at best, even here it is not a frequent complication, suppurative infiltration being the rule, and when abscess does occur it is usually comparatively small and multiple. Abscess is, however, a frequent sequela in all forms of inhalation and deglutition bronchopneumonia. Septicemia or pyemia may also be accompanied by abscess of the lung through infectious emboli. It is especially liable to occur in persons in whom the general health had been poor before the onset of the causative affection, and in lymphatic or alcoholic subjects.

In some forms of bronchopneumonia it is said to be frequently observed. It occasionally presents itself as a complication of abscesses in neighboring structures, the liver particularly; the pleural cavity, and of tumors and cysts.

PATHOLOGY.—The local lesions are merely those of an ordinary abscess, containing micro-organisms, these varying, as stated, with the nature of the causative disease. Streptococci, the *Diplococcus pneumoniae*, and Friedländer's bacillus among others have been observed. The most frequent location (80 per cent.) is in the lower lobes. The size of the abscess may vary greatly from that of a chestnut to that of a large orange. The walls of the abscess are irregular and shreddy. An abscess of long duration shows a dense limiting

peripheral membrane, and closed abscesses considerable cicatricial tissue: a clear indication of the tendency to resolution of these abscesses if the general health can be improved. Pulmonary abscesses may rupture into the pleura, pericardium, or peritoneum.

PROGNOSIS.—The prognosis of pulmonary abscess other than that due to tuberculosis has somewhat improved since paracentesis has been introduced. In abscess complicating pneumonia the prognosis is not as unfavorable as would logically appear. The prognosis becomes very unfavorable, however, when pulmonary abscess occurs as a complication of abscesses elsewhere.

The war has greatly increased the number of such cases, lung tissue being particularly favorable for the growth of infective organisms introduced, with foreign bodies, by continuity of tissue, etc. Such cases have, however, been reviewed under CHEST, INJURIES OF, in the third volume.

TREATMENT.—The main therapeutic indication is the support of the patient's strength by the use of **tonics, stimulants, antiseptics**, and by **forced feeding** with light and easily digested foods. Inhalation of antiseptic **sprays (thymol, phenol, creosote)** is beneficial. In cases other than tuberculous ones the abscess, when superficially located, should be evacuated by aspiration or incision when the diagnosis is certain. It will not only tend to prevent rupture into the neighboring cavities, but counteract the tendency to mortal marasmus which an untreated abscess involves. **Artificial pneumothorax** is recommended by C. W. Richardson in acute pulmonary abscess following operative work in the upper airtract.

Of 10 cases of abscess of the lung treated by **artificial pneumothorax**, 2 died, 2 were temporarily improved, and 6 were cured. The prognosis is poor under medical treatment. The infected organisms are carried into the lung from the field of operation by means of an infected clot. The symptoms appear from 4 to 10 days after operation. Tewksbury (Jour. Amer. Med. Assoc., Feb. 2, 1918).

Fifty of 81 consecutive cases of pulmonary abscess observed in the Mayo Clinic were the result of a primary lung infection, such as pneumonia, a cold, grippe, pleurisy, asthma, measles, etc.; 17 were the result of operations about the mouth, nose, and throat; in 2 cases the abscess was due to septicemia caused by trauma to the lung or its protecting wall; in 5 cases the condition followed an intra-abdominal operation; and in 12 cases no cause was determined. Recovery depends on the establishment of **drainage**, either by natural or surgical measures. Acute multiple abscesses cannot drain and always cause death. Aspiration abscesses, regardless of their size, may drain through the bronchus, cicatrize, and become obliterated. Medical treatment consists of **forced feeding, rest, sunshine, open air, and alkalinization**. When no further improvement can be effected, or if retrogression occurs, **operation** is advisable. Of the 16 patients operated on by Hedblom in 1919, 3 died, a mortality of 18.7 per cent. Norris and Landis give the mortality of cases operated upon as 25 per cent. and of cases not operated upon as 50 per cent. In Walker's series the mortality in cases of acute abscess treated medically was 54 per cent. while in those treated surgically it was 25 per cent. W. S. Lemon (Can. Med. Assoc. Jour., x, 1079, 1920).

When occurring as sequel of pneumonia with free expectoration an expectant plan of treatment is best, unless the process becomes progressive, in which case **surgical measures** are

imperative. In 25 cases of acute abscess following pneumonia reported by Eisendrath 24 patients recovered and 1 improved; in his chronic cases the results were less favorable.

The measures recommended under FETID BRONCHITIS (*q. v.*) are all indicated here.

PULMONARY HEMORRHAGE.

Pulmonary hemorrhage, or bleeding within the lungs, may be caused by various disorders and injuries, and erosion or rupture of the walls of the pulmonary vessels, large or small. It may be most conveniently divided into two forms: *bronchopulmonary* (bronchorrhagia), in which the blood flows into the bronchi and is eliminated through the mouth—constituting hemoptysis, and *pulmonary apoplexy* (pneumorrhagia), in which the blood accumulates in the pulmonary parenchyma, or the lung-tissue and the air-cells.

Bronchopulmonary Hemorrhage.—Although this form of hemorrhage is one of the prominent symptoms of pulmonary tuberculosis, it is important to realize that the latter affection is by no means the only one in which hemoptysis may occur. It is a comparatively frequent accompaniment of cardiac disorders; diseases of the nasal cavities, pharynx, larynx, and trachea; aneurism; menstruation; arthritism; purpura hemorrhagica; hemophilia; the *Distomum pulmonale* and other disorders, and severe injuries of the thorax.

SYMPTOMS AND DIAGNOSIS.

—In rare cases the quantity of blood is so great that the flow occurs from the nose and the mouth simultaneously. In quantity the hemorrhage usually varies from 1 ounce (30 c.c.) to a pint (500 c.c.). Fatal hemor-

rhage may occur in a cavity without hemoptysis (Osler). Again, it may be swallowed as rapidly as it reaches the laryngeal aperture, enter the stomach, and be regurgitated. But, in the majority of cases, the flow is not great; the patient first experiences a warm, salty taste, then ejects more or less great quantities of bright-red, frothy blood. It may be brought up with a cough, or suddenly fill the mouth and be expectorated. Small quantities may be brought up from time to time and merely permeate the saliva with films or streaks. The first hemoptysis may prove to be the last; it may recur a few hours later or the next day. When repeated hemorrhages occur, the last sputa assume a dark aspect; this represents blood which has sojourned in the bronchi, and usually indicates an early cessation. A small hemorrhage causes alarm in the patient, with mental agitation, dyspnea, a sensation of heat in the chest, cardiac palpitation, and other nervous symptoms; large hemorrhages give rise to the symptoms of shock and those of symptomatic anemia and unconsciousness not infrequently occur.

If it is found that the spitting of blood occurred only after a prolonged bout of coughing, it is likely that the blood came from the nasopharynx or pharynx. If it occurred spontaneously, and if the first thing the patient was aware of was the presence of blood or a salty taste in the mouth, and if the hemoptysis went on for some hours or days and was not small in amount, tuberculosis of the lungs is the probable cause. If the patient is a child, care should be taken to exclude the presence of enlarged tonsils and adenoids, on the one hand, and of chronic bronchitis, on the other, before making the diagnosis of pulmonary tuberculosis. The

other physical signs present will be of the greatest service in diagnosis, and in doubtful cases particular care should be given to the examination of the nose, nasopharynx, lungs, and heart. Not less important is the examination of the sputum for tubercle bacilli and for fragments of elastic tissue from the lungs, in any doubtful case. Should the examination prove negative, it must be repeated several times before the exclusion of pulmonary tuberculosis is justifiable. If the patient complains of spitting up streaks of blood every morning when he gets up, and at no other time, then he probably has chronic rhinitis if an adult, enlarged tonsils and adenoids if a child.

The amount of blood expectorated is of some, though relatively limited, value from a diagnostic point of view. A copious hemoptysis from several fluidounces to several pints suggests tuberculosis, aneurism, or bronchiectasis; a moderate hemoptysis, tuberculosis, or mitral disease; from the spitting up of streaks of blood no diagnostic deduction can be drawn. (*N. Y. Med. Jour.*, from *Pract.*, Nov., 1911.)

Blood from the pulmonary tract is usually thoroughly mixed with the sputum and is bright red and foamy. When this is swallowed and then vomited, fresh foamy blood generally comes with it, showing that it is not true hematemesis. The patient often imagines the amount of blood lost as far above what it really is; he must be tranquilized at all costs, and all persons that cannot be relied on must be excluded from the room, whether hemorrhage was slight or severe. The family can be reassured that with tuberculosis hemoptysis is rarely fatal. Grober (*Deut. med. Woch.*, Feb. 26, 1914).

A moderately large or a severe hemoptysis, other gross causes being excluded, suggests a tuberculous, actively evolutive tuberculous lesion, the exceptions being cases of rapidly healing or abortive tuberculosis. Glover (*Practitioner*, Aug., 1918).

Besides pulmonary tuberculosis (see TUBERCULOSIS), of which pulmonary hemorrhage is one of the prominent earlier symptoms, and the diseases—such as purpura hemorrhagica, hemophilia, scurvy, malignant infectious diseases, hepatic cirrhosis, etc.—that are often attended by this symptom, hemoptysis may occur in the following disorders:—

Cardiac Disorders.—Hemoptysis frequently occurs when valvular disorders involving stenosis are present, and especially when the mitral and aortic valves are diseased. Besides the general symptoms of the cardiac affection, the character of the blood assists in establishing the diagnosis. Instead of being bright red and frothy, as in tuberculosis, it is, as a rule, dark and more or less mixed with mucus. It does not present itself in the mouth in sudden jets, but usually comes up as would mucopurulent sputa. Again, the hemoptysis continues several weeks, sometimes without causing untoward symptoms.

Menstruation.—Hemoptysis sometimes replaces menstruation in women (vicarious menstruation). The hemorrhages are then periodical, or they may be observed as a sequel to the menopause and occur repeatedly; also at regular intervals. All such cases should be watched, debility and vulnerability of the pulmonary structures being at times either concomitant or resulting conditions under such circumstances. Periodical hemoptysis is occasionally observed after removal of the ovaries. In hysterical hemoptysis the hemorrhage is slight and pus-cells are absent, but there is present a considerable amount of squamous epithelia, leptothrix, and food remnants (Strümpell).

Nasopharyngeal Disorders.—These are frequently attended by slight hemorrhage; as a rule, the blood is brownish and the symptoms of chronic nasopharyngitis or other local disorders may be present. Tumors, especially fibroma and sarcoma of the nose and nasopharynx, may give rise to copious hemoptysis; but recurrent epistaxis often attracts attention to the seat of the disease. In epistaxis the blood may enter the nasopharynx, cause cough, and be expelled, as in hemoptysis. In a case of my own, copious recurrent hemorrhage was traced to an ulcer in the pharyngeal vault, which proved to be tuberculous. Varices of the pharynx and lingual tonsil occasionally rupture, and may give rise to a copious flow of blood.

Varices at the base of the tongue were responsible for the supposed hemoptysis in 68 cases on record, and these varices occurred in the pharynx in 3 similar cases. In other cases the hemorrhage came from the larynx, which was merely congested, or the bleeding was of neuropathic origin, a menstrual manifestation of a tendency to hemophilia, or a symptom of chronic nephritis or liver disease. Garel and Gignoux (*Lyon méd.*, Dec. 24, 1911).

Laryngeal Disorders.—In cancer and sarcoma of the larynx, angular foreign bodies in the laryngeal cavity, rupture of a superficial vessel, especially after straining or vomiting and laryngitis sicca, hemoptysis is of occasional occurrence. Here, also, the blood usually comes up as would ordinary mucus, but it is often unmixed and distinctly arterial. When due to the presence of tumors, shreds of detritus are often coughed up simultaneously.

Aneurism.—This is not an uncommon cause of hemoptysis, through

the pressure exerted by the aneurismal mass upon the pulmonary structures and erosions of their tissues. The trachea is frequently pressed upon in this manner by aortic and innominate aneurisms and the bleeding spot may occasionally be located with the aid of the laryngoscope. Aneurisms of the pulmonary artery, when they rupture, suddenly fill the lung with blood, causing death. Aortic aneurisms may also rupture into the bronchial tract. The blood is ejected in mouthfuls and the secondary manifestations—pallor, unconsciousness, etc.—rapidly follow.

Vascular Fibrosis.—In atheromatous degeneration, especially in elderly persons, the pulmonary capillaries and small vessels of the bronchi sometimes yield, giving rise to a more or less copious flow. This form of hemoptysis has been called by Sir Andrew Clark "arthritic hemoptysis," since it is usually met with in arthritic subjects. It has occasionally proved fatal; but, as a rule, it constitutes a benign form of hemoptysis.

Emphysema.—This affection is sometimes attended by hemorrhage. The blood, unless the quantity be great, is not brought up as it leaves the ruptured capillaries; it usually sojourns some time in dilated alveoli, and is coughed up in thick masses, which sometimes assume the shape of the smaller tubes and are voided as casts.

Thoracic Injuries.—Blows upon the chest, besides penetrating and crushing wounds, often cause hemoptysis, which may continue several days. (See THORAX, INJURIES OF.)

Unassignable Causes.—Finally, recurrent hemoptysis sometimes occurs

without apparent cause, notwithstanding careful search, and the subject, after a period of great anxiety, does not find his health to have been impaired, and lives many years—sometimes as a standing negation of an injudicious and hasty diagnosis. Now that microscopic examination of the sputum alone forms the basis of the decision when tuberculosis is suspected, such errors are not as frequent. Cases of this kind, however, should be watched, and, if the patient be weakly and anemic, measures tending to improve the general tone should be instituted and continued long enough to restore the patient to perfect health.

The frequency of hemoptysis in Asiatic troops and workmen from Indo-China and other Oriental countries was noted by the writers. They recall, however, that bronchitis in an Asiatic that drags along and is accompanied by blood in the sputum, calls for hospital care and strict disinfection of the sputum, as it is liable to contain the eggs of the *Paragonimus westermanni* or *Distoma ringeri*. They insist that the discovery of distomatosis of the lungs is a warning to deport the patient if his condition permits. These are the only means to prevent development of foci of endemic distomatosis. Salomon and Neveu (Revue de Méd., Nov.-Dec., 1916).

Pulmonary Apoplexy (Pneumorrhagia).—This consists in extravasation of blood into the air-cells and interstitial pulmonary tissue, as a result of aneurismal rupture, penetrating wounds, ulceration involving a large vessel, septicopyemia, cerebral disease, and other conditions in which the pulmonary parenchyma is torn. In circumscribed pneumorrhagia the blood may be effused into the air-cells and the interstitial tissue, without laceration of the pulmonary

parenchyma, as in cases of pulmonary embolism or hemorrhagic infarction.

Diffuse pulmonary apoplexy arises from a rupture of a thoracic aneurism that has become adherent to the lung-surface. Its more usual course is traumatism, particularly penetrating wounds. It is more common in adult males.

As here understood, pulmonary apoplexy only applies to rarely observed cases in which the organ is overwhelmed with blood, which gushes out of the mouth in great volume. Intense dyspnea, collapse, and death follow in quick succession. In some cases the hemorrhage is, so to say, localized, and the hemoptysis is not severe. Soon, however, an abscess and at times gangrene appear, and the patient succumbs from septicopyemia.

TREATMENT OF PULMONARY HEMORRHAGE.—The treatment of pulmonary hemorrhage not only varies with the cause, but therapeutic measures addressed to the cardiovascular system at large are also necessary. Examination of the upper respiratory tract, the nasopharynx, the pharynx, the larynx, the trachea, the base of the tongue, etc., may reveal a bleeding spot and call for the local application of **styptics**; besides this, however, measures tending to reduce the vigor of cardiac action—**rest**, etc.—must be resorted to. A third class of therapeutic indications are those calculated to prevent the recurrence of the hemorrhages.

If the hemorrhage is a copious one, the patient should at once be placed in a **reclining position**, his **head** being turned to **one side** to enable him to clear his mouth as fast as it is filled.

Whatever be the cause of the bleeding, it cannot be clearly established while it lasts; general measures are therefore alone indicated for the time being. Several remedies at present commonly employed are more pernicious than helpful, particularly ergot and the ice poultice. Ergot increases vascular tension; the ice poultice contracts the peripheral vessels and causes engorgement of the deeper vessels.

Probably the most effective agents are **morphine** and **atropine**, $\frac{1}{4}$ grain of the former and $\frac{1}{100}$ grain of the latter, given together hypodermically. At the same time, a large handkerchief, napkin, towel, or **bandage** should be **tightly wound around each extremity**, as near the trunk as possible, to momentarily arrest the return of the venous blood to the thoracic organs. This procedure, if properly carried out, at once reduces the pulmonary engorgement and usually arrests the flow unless it is overwhelming. **Nitrite of amyl** is another remedy which acts promptly. Fish reports excellent results from the **inhalation of chloroform** in 19 cases. He uses from $\frac{1}{2}$ to 1 fluidram (2 to 4 c.c.) at once; later, the inhalation of 15 or 20 drops every hour is used for several days. Foxwell advises **venesection** when venous congestion is present, combined with measures that confine the blood to the systemic circulation (**nutritious food**, large doses of the **nitrites**, **hot foot baths**, **leeches to the anus**, and **ligatures to the thighs and arms**). Anders has found **dry cupping** over the chest of great service in cases dependent upon congestion, combined with the free use of **iced drinks** and the eating of **ice**. Wilkinson asserts that **tuber-**

culin has prophylactic and curative action. When these agents cannot be obtained, a tablespoonful of **salt** dissolved in a tumblerful of water generally arrests the flow when the bandages are also applied as stated.

The writer obtained excellent results from the use of **amyl nitrite** in cases of hemorrhage due to bullet wounds of the lungs. He used 5-minim (0.3 c.c.) pearls by inhalation. When it is desired to maintain the effect, the writer administers **nitroglycerin** and **sodium nitrite** in small and oft-repeated doses. Sweet (Military Surgeon; Monthly Cyclop., May, 1908).

A combination of **epinephrin**, **calcium chloride**, and **opium** is almost specific in hemoptysis; other remedies have been overrated. Locally, **ice** and **mustard** are valuable. If these fail, **ippecac** and **tartar emetic** may stop the flow. Gilbert (Paris méd., July 13, 1912).

The subcutaneous injection of 40 c.c. ($1\frac{1}{2}$ fluidounces) of **sterile gelatin solution** causes a twenty-four hours' rise in viscosity of the blood by 1.4 of original value, and reduces tendency to hemoptysis. Cmunt (Med. Klinik, Aug. 25, 1912).

Gratifying results from **intravenous saline infusion** in 50 cases; 5 c.c. (80 minims) of a 10 or 15 per cent. **solution of sodium chloride** used. Causes no pain and is entirely innocuous. Müller (Beiträge z. Klinik der Tuberkulose, Bd. xxviii, Nu. 1, 1913).

If the blood-pressure is less than 110 the writer gives an intravenous injection of 0.5 Gm. ($7\frac{1}{2}$ grains) of **ergotin** dissolved in 1 c.c. (16 minims) of distilled water. If the blood-pressure is higher than 110 there is injected in addition 0.001 Gm. ($\frac{1}{4}$ grain) of **morphine hydrochloride**. A few minutes after the administration the cough and hemoptysis cease. Garmagnano (Riforma Medica; Charlotte Med. Jour., Nov., 1913).

Camphorated oil is of great value. Volland has also been very success-

ful with subcutaneous injections of from 25 to 30 Gm. (6¼ drams to 1 ounce) of a 10 per cent. camphorated oil. But the writer has found it preferable to give moderate doses of the 20 per cent. oil. It hardly ever fails. Zehner (*Zeit. f. Tuberk.*, Aug., 1920).

Throughout, the patient should be kept absolutely **quiet**. He should be informed that his hemorrhage is not likely to prove lethal, and also enjoined against unnecessary coughing.

Excellent results have been obtained in hemoptysis by hypodermic injections of $\frac{2}{3}$ to 1 grain (0.04 to 0.06 Gm.) of **emetine hydrochloride**, and by hypodermic or intravenous administration of **pituitary extract** or in the form of pituitrin, 8 minims (0.5 c.c.) at a dose.

The results which the writer has obtained from the use of **pituitrin** in human beings suffering from hemoptysis have been excellent. In 10 cases immediately following the injection of the pituitrin intravenously there was complete arrest of the hemorrhage, and the local physical signs over the area from which the blood was supposed to come were materially modified. Rist (*Bull. et mém. de la Soc. méd. des Hôpitaux de Paris*, Apr. 24, 1913).

Subcutaneous injection in flank or thigh of 0.04 Gm. ($\frac{2}{3}$ grain) of **emetine hydrochloride**, dissolved in 1 c.c. (16 minims) of water, gave striking results in 20 cases. Bleeding was constantly and immediately arrested. There was no unfavorable accompanying effect. One should repeat the measure in twelve hours, again the next day, and if necessary subsequently, to make sure of preventing recurrence. Flandin (*Presse méd.*, Sept. 24, 1913).

The writer has tried **emetine** in 8 cases, but his experience was not so favorable as those previously reported. He found that 2 or 3 injections were necessary and larger

doses. The dose advocated by Flandin and Joltrain is 0.04 Gm. ($\frac{2}{3}$ grain), but 0.05 to 0.06 Gm. ($\frac{2}{3}$ to 1 grain) is none too much. Even larger doses than this could be used to advantage. Guerrero (*Semana Medica*, Dec. 25, 1913).

Nothing has such a rapid and effective action in arresting hemoptysis as emetine. Without nauseating or reducing the blood-pressure appreciably, the tendency to hemorrhage is arrested almost at once by injection of 0.04 to 0.06 Gm. ($\frac{2}{3}$ to 1 grain) of **emetine hydrochloride**. This occurred apparently irrespective of the cause of the hemoptysis, whether it was the result of a tuberculous or pneumonic process or of perforation into a bronchus of an amebic abscess of the liver. Aubert, Bouyer, and Chaufford (*Bull. de l'Acad. de Méd.*, Jan. 20, 1914).

Grünbaum administers 2 minims (0.12 c.c.) of **tincture of aconite** (B. P.) every hour until the pulse is reduced below 65 or becomes irregular, or the blood-pressure falls below 90 mm. of mercury.

After the hemorrhage has ceased, the patient should remain where he is an hour or so, then be carried on a litter to a cool room. He should not be allowed to speak. Fainting tends to assist the formation of a clot, and the patient, as a rule, recovers his senses within a short time. The bandages should be removed gradually, fifteen minutes being allowed to elapse between each operation, so as to avoid a sudden tension of the pulmonary arteries. **Aconite** or **veratrum viride** may then be used with advantage.

The **diet** should be light, and easily digested food should be selected. Alcoholic and other stimulants should be strictly forbidden. Large quantities of liquid of any kind and hot

beverages tend to bring on a recurrence of the flow. To assist in preventing this, the formation of a clot should be encouraged; this is best accomplished by **calcium chloride**, 10 to 15 grains (0.6 to 1 Gm.) every two hours in glycerin, or **calcium lactate**, 30 grains (2 Gm.) in solution, three times a day. **Saline purgatives** are valuable to reduce vascular tension, but they should not be utilized when the patient has been greatly weakened by the hemorrhages if other measures are effective. **Magnesium sulphate** in the dose of 1 to 2 ounces (30 to 60 Gm.) is frequently used.

The tuberculous who spit a little blood morning or night, and none the rest of the day, almost always have some circulatory trouble. Let them **drink water** and live on a **vegetarian diet**, and 9 out of 10 will lose the last trace of blood in forty-eight hours. Forced feeding is injurious for the tuberculous with a cardiac taint; they should drink as little as possible with their meals, to prevent distention of the stomach and its injurious action on the heart. When the patients once realize the benefit from these rules, they apply them habitually, eating little meat, masticating with special care, and drinking water only between meals. Sabourin (Arch. gén. de méd., Aug., 1912).

The hemoptysis observed in *elderly persons*, and due to vascular disorders, is, according to Sir Andrew Clark, aggravated or maintained by the frequent administration of large doses of strong astringents, by the application of ice-bags to the chest, and by indulgence in liquids to allay the thirst created by the astringent. The treatment found most successful by him in these cases is **diet; quiet, restricted use of liquids, stilling of the cough, calomel, salines, alkalies with iodide of potassium**, and frequently

renewed counterirritation. (See also TUBERCULOSIS.)

In all cases the cessation of hemorrhage should not interrupt treatment, as in many cases there is a tendency to recurrence. For small and repeated hemorrhages, **turpentine** and **aromatic sulphuric acid** are indicated. The use of **stimulating food, tobacco, alcoholics**, and all **physical and mental strain** should be **forbidden**. Bronchial irritation should be avoided, and attacks of bronchitis, though mild, should be carefully treated. An **inland climate** is advised, with **moderate exercise** and **abundant nutritious food**.

PULMONARY EMBOLISM (HEMORRHAGIC INFARCTION; EMBOLISM OF THE LUNG).

This consists of a mechanical obstruction of one or more pulmonary arteries by an embolus or thrombus.

SYMPTOMS.—While a diminutive infarction may pass unnoticed, complete occlusion of a large pulmonary artery may occasion instant death. Symptoms arise when the embolus does not completely fill the lumen of the artery involved, or when the latter is not of sufficient size to completely disturb the pulmonary circulation, even though the vessel be completely occluded. Under these circumstances, dyspnea is experienced. It gradually increases in severity, and may be preceded by unconsciousness and convulsions. The patient gasps for breath and indicates, by his frantic efforts to inhale, the intensity of his suffering. The pulse becomes weak and thready; the skin is cold and clammy and is covered with sweat. Severe localized pleuritic pain and a hard and harassing cough are usually present, and the patient

expectorates masses of bloody or dark gelatinous mucus. This reveals, upon microscopic examination, peculiar large lymph-cells resembling alveolar cells and containing blood-corpuscles. These giant cells are thought to transform the blood-corpuscles into pigment-matter. They are seen especially in cases of heart disease, and are known as the "cells of heart-failure" (Whittaker). As the case progresses, local suppuration with metastatic abscesses occurs, and all the evidences of pyemia may appear. Dissolution of the thrombus may take place and the abscesses may undergo resolution, but, as a rule, the prognosis is serious.

Tragic deaths from pulmonary embolism, both after operations and confinements, are due principally to a hyperfibrinous blood. All patients should drink water freely. He also urges that the position of the patients be changed frequently and that they move their limbs freely as soon as possible, and that they sit on a chamber in bed to pass water and move the bowels. Lying on the back for ten days, with the blood getting more clottable daily is a very good way to bring about thrombosis and death by embolism when the patient begins to move about. Pulmonary embolism is rare, only 47 deaths having occurred from it at the Mayo Clinic in 63,000 operations. A. L. Smith (Brit. Med. Jour., June 8, 1918).

DIAGNOSIS.—When associated with the symptoms enumerated,—dyspnea, syncope, bloody expectoration, etc.,—the physical signs assist in establishing the diagnosis. But they are only clearly obtained when the lesion is not too deeply seated. A localized consolidation giving rise to dullness under percussion, bronchial respiration, increased fremitus, moist râles, and a friction-sound,

when the tension is near the pleura, represent the only signs which may be attributed to the embolus, all others being due to conditions developed secondarily.

ETIOLOGY AND PATHOLOGY.

—Pulmonary embolism is due to stasis, in the majority of cases, the primary factor being a pulmonary or cardiac affection. The infarct generally consists of a wedge-shaped mass of leucocytes and red corpuscles with its base usually at the pleura, which soon becomes dull looking and covered with fibrin. It is usually firm, airless, and black or brownish and varies in size from that of a cherry to that of an entire lobe, since in some cases the entire vascular supply of a lobe is involved. Its envelope is formed of a thin film of fibrin. Hemorrhagic infarctions often develop near the pleura and at the back of the lower lobe. They may be single or multiple and may involve the greater part of the lobe, though usually they are about the size of a walnut. Their seat of election is at the back of the lower lobe. Leucocytes and red blood-corpuscles are present in the air-cells and in the alveolar septa. Collateral congestion and edema are usually present; seldom is there consolidation of the lung.

In 50 per cent of cases of puerperal embolism of the lungs the women were under 30; post operative embolism generally occurs in patients more advanced in years. Embolism of a large vessel is generally readily diagnosed even when it is impossible to discover the primary thrombus. In 65 per cent. of the cases death occurred without the slightest clinical warning. In 66 per cent. of all the known cases of fatal embolism of the lungs the main trunk or one or

both of the main branches was plugged by the embolus, so that the anatomical conditions would have favored its **removal**. In 64 per cent. of the cases fifteen minutes or more elapsed between the first symptoms of pulmonary embolism and the patient's death, so that there might have been time to do the **Trendelenburg operation**. On the whole, the conditions are more favorable in the puerperium for the operation for pulmonary embolism than when the embolism follows an operation. Vogt (Jour. Amer. Med. Assoc., from Zeit. f. Geburts. u. Gynäk., Bd. lxxiii, Nu. 1, 1913).

Of 45 cases of death from embolism following operation, 38 occurred after abdominal operations. It rarely occurs under 30 years of age and is most frequent above 45 years. In view of the frequency of cardiac and vascular changes in such persons they may be regarded as causative agents in a large number of cases. According to the autopsy findings the source of the embolus after laparotomies and after operations for hernia or upon bladder or rectum is often to be found in the hypogastric and femoral vein, and not rarely in the vena saphena or spermatic vein. Pulmonary embolism in one-half the cases occurred from four to fourteen days after operation. In one-half of the cases the patient died within ten minutes after the lodgment of the embolus. The author regards it as improbable that infection is the cause of the postoperative thrombosis preceding the embolism, and considers reduced cardiac activity and circulatory disturbances associated with the operation and post-operative period as the essential factor in many cases. G. Petren (Beitr. z. klin. Chir., Bd. 84, Hft. 2-3, 1913).

Personal experience which confirms Brauer's statement that embolism may occur from air getting into a pulmonary vein without coming directly from the exterior. It is immaterial whether the embolism is

caused by oxygen, nitrogen, or air, and it is probable that certain cases published as pleural epilepsy were in fact cases of air embolism. F. Jessen (Deut. med. Woch., June 26, 1913).

In embolism of the pulmonary artery the exertion which causes the embolism is one in which the abdominal muscles are strongly contracted, especially turning over without help in bed during convalescence from a major operation, or movements of the arms or legs. **Physical rest** is, therefore, the main point in warding off further embolism if the patient has survived the first symptoms. Patients should not be allowed to get up soon after an operation on the pelvis. Grober (Deut. med. Woch., Feb. 19, 1914).

TREATMENT.—This can usually only be symptomatic, the patient's strength being sustained and his **position** so adjusted as to facilitate respiration; this is usually best accomplished by **elevating the upper part of the body**. In addition to **absolute rest** of the body and relief of the distressing symptoms, treatment should be directed against the causative disease. Dyspnea and pain may be relieved by the use of **morphine** and **atropine** or **heroin**. Gessner recommends hypodermic injections of **ether** or **morphine**.

Where embolism has actually taken place the following symptomatic measures will alone prove of value:—

To overcome dyspnea and the tendency to syncope injections of **camphor** and **ether** should be given every hour:—

R. *Camphoræ* 3v (20 Gm.).

Aetheris f3viss (25 c.c.).

Olei olivæ sterilis-

sati q. s. ad f3iiss (100 c.c.).

M. Sig.: Give hourly injections of 30 minims (2 c.c.).

One or two liters of **oxygen** should simultaneously be injected under the

skin, and their effect kept up with repeated oxygen inhalations.

Next, **dry cups** should be applied to the **chest**, and, if hemoptysis is not marked, from 4 to 6 of the **areas** may be **scarified** on the side that is subjectively painful. **Venesection** is indicated only where there are evidences of pulmonary edema. Where pain is not relieved by the cupping an injection of **morphine** should be given, to be immediately followed by one of **ether** or **sparteine**.

Cough, which is generally marked, should be assiduously combated, as it increases dyspnea and favors hemoptysis:—

℞ *Extracti opii* .. gr. ⅙ (0.01 Gm.).
Extracti hyoscyami,
Extracti stramonii gr. ⅓ (0.005 Gm.).

Fiat pilula no. j.

Sig.: One pill every two or three hours.

To prevent, in so far as is possible, suppuration or gangrenous degeneration of the infarct, a tablespoonful of the following mixture may be placed in a vessel containing water that is kept boiling:—

℞ *Olei thymi*,
Olei eucalypti,
Olei terebinthinæ f̄iiss (10 c.c.).
Tinctura benzoini. f̄3j (30 c.c.).
Alcoholis ..q. s. ad f̄3viiij (250 c.c.).

Misce.

Another available procedure is to pass the oxygen that is being inhaled by the patient through the following combination, contained in a flask:—

℞ *Thymolis* gr. xlv (3 Gm.).
Eucalyptolis m̄lxxv (5 c.c.).
Phenolis gr. lxxv (5 Gm.).
Alcoholis absoluti. f̄3iv (125 c.c.).
Aquæq. s. ad Oij (1000 c.c.).

Misce.

In exceptional cases surgical intervention—**Trendelenburg's operation**—can be undertaken. Oppenheim (N. Y. Med. Jour., from Progrès méd., Feb. 15, 1913).

If the patient survives the first hour, his pain and distress must be relieved with **morphine**. This is particularly useful in case of embolism in the smaller branches of the pulmonary artery, which often is accompanied by intense pain in the pleura. This can be combated with **ice** or **mustard**, **cold-water bandaging**, or **wet cupping**. Grober (Deut. med. Woch., Feb. 19, 1914).

Surgical treatment has been attempted in a few cases by Trendelenburg and others, with partial success.

One is justified in attempting to remove the obstruction embolus, as Trendelenburg's and Siever's patients lived afterward for thirty-seven and fifteen hours and Kruger's for over five days, succumbing finally to purulent pleuritis. But it is useless to attempt operative removal of the embolus if there is heart disease or wasting sickness. Schumacher (Archiv f. klin. Chir., Bd. ci, Nu. 3, 1913).

PULMONARY EDEMA.

DEFINITION.—Edema of the lungs is due to the escape of serum through the vascular walls into the alveolar wall and interstitial tissue. It is a secondary condition, is generally associated with pulmonary congestion, and is usually bilateral.

SYMPTOMS.—Edema appears and progresses more or less insidiously, the dyspnea resulting from reduced respiration being marked in proportion. The respiration at first becomes hurried; a feeling of suffocation is experienced, accompanied by considerable anxiety and great muscular effort to facilitate the respiratory act. Cyanosis soon appears if the effusion involves much interstitial tissue, particularly when collateral edema exists, and intense suffering is sometimes witnessed. The infiltration is usually bilateral and ascends from the lower lobes.

The sputum may not be increased at first, but, as soon as the quantity of serum in the alveoli becomes great, it becomes very abundant and frothy and is expectorated with great difficulty. In some cases it is thin and watery; in others it is sufficiently viscid to markedly increase the dyspnea through laryngeal obstruction. A peculiarity of the sputum at this stage is that it is more or less tinged with red, due to the presence of red blood-corpuscles. It may also contain urea.

The pulse is generally rapid and feeble, the weakness increasing as the infiltration progresses. No fever is present unless due to an intercurrent or underlying affection. The extremities become cold and the patient in extreme cases dies from heart-failure and carbon dioxide poisoning.

Arterial tension in acute pulmonary edema. Before seizure, the minimal (diastolic) tension is raised, and the maximal (systolic) tension is also very high; during the seizure circulation is suddenly modified, and the two tensions decrease, though not to the same degree. After the seizure, if death supervenes, the pulse first becomes more and more rapid; if not, the minimal tension remains about the same, and the maximal tension increases. If, in a given subject, one notes a marked hypertension, maximal and minimal, a prophylactic régime is indicated; **salts** should be **diminished or withdrawn**, a **lactovegetarian diet** ordered, and **diuretic mineral waters** given. Amblard (*Presse méd.*, Aug. 12, 1911).

Examination at once reveals the reduced respiratory area, through inspection, the motions of the chest being restricted; percussion shows dullness over the infiltrated regions and resonance—at times tympanitic—above; auscultation, eliciting moist

mucous and submucous râles, with gurgling, with inspiration and at the beginning of expiration over the site of the edema, increasing as the involved tissues are approached. The vesicular murmur is feeble or absent, or there may be bronchovesicular breathing. With Bianchi's phonendoscope the gradual progress of the edema can generally be traced with accuracy.

A recurring variety has been noted by Crummer, Riesman, and others, appearing without any apparent cause and not infrequently proving fatal. The chief symptoms are agonizing dyspnea, cyanosis, cough, expectoration of frothy, albuminous fluid, and profound prostration. Recovery from an attack is frequent and sudden (Riesman).

Three cases of acute diffuse edema of the lungs occurring in women in a fair state of health, suddenly and at night. They were 48, 50, and 67 years of age, respectively. Two died. One case might be considered as of cardiotoxic origin, the other 2 of the cardioneurotic type. Previous examinations of the urine failed to show evidence of nephritis. There was absence of the radial pulse in all 3 for a time, *i.e.*, greatly lessened blood-pressure. Yount (*So. Calif. Pract.*, Mar., 1911).

In the writer's twenty-seven years' practice paroxysmal edema of the lungs was met with 4 times. The attack most often commences with some irritation in the throat, tickling, and a feeling of dryness, with slight cough, and the patient has a fear of some serious happening. He can not, dare not, lie down; breathing at once becomes rapid; the face looks anxious and is pale. There is generally, but not always, some cyanosis with the pallor. The skin is cold and moist; breathing is oppressed and urgent; cough grows more dis-

trekking, and there is some expectoration of frothy, coagulable fluid, frequently blood-stained; the chest is rapidly filled with noisy râles; the pulse is small and quick; expectoration at times becomes profuse. This condition continues for, perhaps, half an hour to an hour and a half, then gradually disappears. Flemming (*Bristol Medico-Chir. Jour.*, June, 1913).

DIAGNOSIS.—The diagnosis is not difficult, owing to the comparative suddenness of the onset, the demarcation between the free and the infiltrated areas, and the absence of fever.

Bronchopneumonia.—This affection presents some points of resemblance; but the fever is marked and the physical signs are different, no clear distinction being traceable between the affected and non-affected areas. The mucous râles occur late in the course of the disease; in the edema they are present almost from the start. The expectoration is glairy and tenacious.

Hydrothorax.—This affection also presents considerable resemblance to edema, but change of position does not alter the area of dullness in edema, whereas the flow of liquid to another part of the chest causes a corresponding change in the seat of the dullness in hydrothorax.

Moist râles are not apt to be present in hydrothorax unless it is due to a concomitant disorder.

Pulmonary edema at the apex simulates tuberculosis and may be accompanied by bronchial adenopathy. Radiography serves in diagnosis. Brunon (*Presse méd.*, May 3, 1911).

In a woman of 62, attacks of suffocation and hemoptysis were substituted for acute lung edema in chronic insufficiency of the left ventricle. Gallavardin (*Médecine*, Mar., 1921).

ETIOLOGY AND PATHOLOGY.

—Edema of the lungs usually occurs as a final complication of other affections, but it may appear idiopathically after a too-hot bath, the copious ingestion of ice water, etc. It is thought to be due to one of three general causes: paresis of the vascular walls, impediment to the free circulation in a diseased organ, or disease of the vessels with increased permeability. Huchard suggests that the increased permeability of the vessel-walls is due to impairment of their nutrition and disturbance of the cardio-pulmonic innervation. This occurs in the form due to toxic and infectious diseases, when the blood has undergone more or less change in cachectic states, uremia, general septicemia, etc. Pulmonary edema, due to vasomotor relaxation from toxic states, sometimes develops rapidly. Vascular paresis appears to be the source of the infiltration in cases occurring suddenly in healthy persons. Impediment to the circulation is found in connection with acute and chronic Bright's disease, of which it is a very frequent complication as a terminal manifestation of dropsy, septicemia, pneumonia, and other infectious diseases. In the latter case the sputum is usually more deeply blood-tinged than in the form due to renal trouble. It is also met with in grave anemia, cerebral injuries, and valvular heart affections. Increased fluidity of the blood and increased tension in the pulmonary vessels are marked factors in many cases. The increased blood-pressure may be due to a failure of cardiac power, and particularly to failure of the left ventricle (Welch). Edema may occur from weakness of the right ventricle alone. It may

also occur as a result of hypostatic congestion; it is then termed "hypostatic edema."

The transudation of serum may either be local (*i.e.*, limited to an area involved in an inflammatory process [pneumonia, abscess, or pulmonary infarction] through which the vascular walls are weakened, and osmosis of the serum rendered possible) or general. In the latter type the transudation, serous or serosanguinolent, invades the tissues and alveoli, and the lung at autopsy is much heavier than the normal organ in water, but does not sink. It is boggy and pits on pressure; on section there exudes a serous or serosanguinolent (if congestion is present) fluid of low specific gravity, and containing less albumin than plasma. Edema is most frequently found at the bases of the lungs, but may be uniformly distributed throughout that organ. Hydrothorax may coexist.

The writer found 10 cases on record in which edema developed in the lungs in pregnancy and the puerperium in consequence of some heart lesion, with only 3 survivals; 6 cases in which the edema was the result of the toxemia of pregnancy, with 3 survivals, and 12 cases in which the edema followed administration of pilocarpine given to relieve albuminuria or eclampsia. Six of the women in this group recovered. It is necessary to distinguish between passive and active edema. The former is generally from a chronic tendency to edema, while the active form is due to congestion and vasodilatation of the arterioles and capillaries in the lungs. L. Pouliot (*Arch. gén. de méd.*, Dec., 1909).

Two cases of aneurism of the aorta in which cardiac asthma seemed to be preceded by an abrupt rise in blood-pressure, and this was followed by acute edema of the lungs. K.

Petren and G. Bergmark (*Berl. klin. Woch.*, Dec. 27, 1909).

Observations by the writer in 5 cases show the importance of acute edema of the lungs as a concurrence in epilepsy. Ohlmacher (*Amer. Jour. Med. Sci.*, Mar., 1910).

Many cases of paroxysmal pulmonary edema are due to giant urticaria of the mucous membrane of the pharynx and larynx. Such attacks sometimes follow an ordinary urticaria, or may be caused by alcohol, syphilis, various drugs, hysteria, the climacteric, intestinal parasites, abnormal genital conditions, or by faulty or peculiar metabolic processes—shown by certain articles of diet provoking an attack. McNeil (*Brit. Med. Jour.*, Aug. 19, 1911).

The etiological factors in acute pulmonary edema are: (1) Renal disease, especially interstitial; (2) aortic affections and arterial cardiopathies; (3) pleuropulmonary affections, such as pleurisy and pneumonia; (4) thoracentesis, when the effusion is too rapidly withdrawn; (5) certain infective states, eruptive fevers, acute articular rheumatism, influenza, typhoid, erysipelas; (6) certain nervous affections; (7) intoxications and dyscrasia, such as acute alcoholism, but only when the kidney is damaged; the injection of saline solutions, owing to sudden increase of arterial tension; inhalations of nitrite of amyl; the use of iodide of potassium, and, lastly, gout. In most instances acute pulmonary edema is due to Bright's disease. A. Robin (*Med. Press and Circ.*, Feb. 21, 1912).

PROGNOSIS.—The prognosis of pulmonary edema is grave in all cases in which it occurs as a complication, its gravity depending on that of the causative affection. In the so-called "idiopathic" cases, those occurring independently of any primary disease, the chances of recovery are much greater. The edema secondary to a

general dropsy due to cardiac or renal disease often causes rapid death. Inflammatory edema following lobar pneumonia presents a particularly unfavorable prognosis.

TREATMENT.—Edema of the lungs being due in practically all cases to another disease, the treatment of the latter is the foundation of the measures to be adopted plus one very important indication: to sustain the heart by every means possible, heart-failure being the main cause of death. The condition of the kidneys must also be closely watched. **Caffeine**, **digitalis**, and **strychnine** are the mainstays as far as remedies are concerned. **Nitroglycerin** and **atropine**, particularly the latter in full doses ($\frac{1}{50}$ grain—0.0013 Gm.—repeated every hour if required), are often beneficial. When pulmonary edema occurs in children 3 minims (0.2 c.c.) of the **tincture of strophanthus**, given every three hours, will give relief.

Derivatives are of value to relieve as much as possible the vascular engorgement. In the early stages a **hot mustard foot bath** affords considerable relief, especially if coupled with the copious use of **dry cups** over the infiltrated area.

The **position of the patient's body** should be **frequently changed**, so as to prevent hypostatic congestion.

When the edema shows signs of increase or when the case from the start assumes severe symptoms, **venesection** should at once be resorted to. If the pulse is full and the heart acting vigorously, the spasm of the minute arterioles can, according to O'Donovan, be as readily relieved by **nitroglycerin** or **morphine** as by the depressing effect of the **abstraction**

of blood. If the immediate origin of the trouble is the weakened muscle of the heart, showing its feebleness by frequent, irregular, and inefficient contractions, with a small and fluttering pulse, one should give at once under the skin $\frac{1}{100}$ grain (0.0006 Gm.) of **atropine sulphate**, with $\frac{1}{50}$ grain (0.0012 Gm.) of **strychnine sulphate**. This is to be inserted just below the clavicle in order to reach the heart with the least loss of time. While this is being absorbed attention can be given to preparations for venesection, if it should prove necessary. Atropine rapidly contracts the vessels, powerfully stimulates the sympathetic system, increases the force of the heart's beat, raises arterial tension, stimulates the respiratory centers, and dries up the secretions of the skin and mucous membranes. The dose required is whatever may be sufficient to produce its physiological effect, easily gauged by watching the amount of dilatation of the pupil. It is safe to begin with $\frac{1}{200}$ grain (0.0003 Gm.), and repeat in a half-hour or at longer intervals until the system is well under its influence.

Artificial respiration will prove more prompt and effective than any medication whenever the edema and cardiac incompetence are of sudden development and due to causes likely to prove of brief duration or removable by appropriate treatment. Emerson (Arch. of Intern. Med., May, 1909).

Case in which the edema seemed to be controlled by procedure as for **artificial respiration**. The patient was relieved at once. The dyspnea seemed to be most pronounced during expiration, and **compression of the thorax** at each expiration was kept up for an hour and a half until the patient was entirely at ease.

Kulenkamp (Deut. med. Woch., Aug. 12, 1909).

Pulmonary edema is usually a manifestation of some circulatory disturbance, which may be due to high blood-pressure. In the latter case drugs that increase arterial tension are contraindicated. The blood-pressure should be reduced by **bleeding, counterirritation** to the surface of the body, or drugs. The type of edema associated with low blood-pressure should be treated by drugs raising the blood-pressure. The writers advise against the use of atropine in pulmonary edema associated with high arterial tension. Atropine is frequently recommended in pulmonary edema, because of its power to lessen secretions. However, the edema is not due to an increase of secretion, but to a transudation. Epinephrin is probably never useful, and often may be dangerous. **Inhalation of oxygen** is harmless, and often gives temporary relief. **Morphine** is decidedly beneficial in any type of pulmonary edema. Miller and Matthews (Arch. of Intern. Med., vol. iv, p. 356, 1909).

The writer refers to 3 cases on record like his own in which **vaginal Cesarean section** was done to relieve fulminating edema of the lungs. His patient was a multipara of 38 who had had edema, nausea, and tendency to dyspnea at night during the first three months of the pregnancy. Pulmonary edema developed suddenly at the eighth month, unmodified by the usual measures; the patient lay in coma, and pulseless at times. She began to breathe better immediately after vaginal Cesarean section, and was soon convalescent. Mossini (Zentralbl. f. Gynäk., Jan. 21, 1911).

When, at the earliest threatening of paroxysmal pulmonary edema, **ammonium carbonate** has been immediately administered, an injection of **morphine sulphate**, $\frac{1}{4}$ grain (0.015 Gm.), with **atropine sulphate**, $\frac{1}{250}$ grain (0.00027 Gm.), may be so efficacious as to render other lines of

treatment unnecessary. This may be followed later by injections of **strychnine** and **nitroglycerin**. Chloroform also controls attacks and in 1 case, with a record of 72 attacks, the patient was relieved in from ten to thirty minutes, but because of its possible dangers in heart disease it can hardly be recommended. Nitroglycerin and the nitrites ought to be useful theoretically, but both are practical failures, probably because in cases of persistently high pressure and arteriosclerosis the vasomotor mechanism has been exhausted and vasodilatation has ceased to be available. Relief is also obtained from **venesection**. Stengel (Progressive Med., Sept., 1911).

The patient must be put on the **lactovegetarian diet**, the action of the heart being improved by the administration of **digitalin** in cardiotonic doses. The next thing is to try to reduce arterial tension, with which object in view the writer prescribes as follows:—

R. Sodii nitritis gr. xv (1 Gm.).
Sodii lactatis 3j (4 Gm.).
Sodii silicatis 3ss (2 Gm.).
Potassii bicarbonatis 3ij (8 Gm.).
Aquæ destillatæ .. f3iv (120 c.c.).

Ft. solutio.

Sig.: Three or four tablespoonfuls every hour for four hours.

A. Robin (Med. Press and Circ., Feb. 21, 1912).

PULMONARY ATELECTASIS.

DEFINITION.—Atelectasis is a congenital or acquired inability to adequately expand all the pulmonary air-cells, and results in imperfect oxygenation of the blood. The congenital form, or “blue baby,” is treated under **NEWBORN, DISORDERS PECULIAR TO**, to which the reader is referred.

SYMPTOMS.—The symptoms of the acquired form depend upon the degree of involvement of the respira-

tory tract. If but a few lobules are collapsed, compensatory action of other parts of the lung annuls the deficiency. If, however, the portions involved compromise about one-eighth of the respiratory capacity, there is dyspnea and imperfect oxygenation. Atelectasis is always a secondary condition and its symptoms are generally masked by those of the primary disease. It may arise in the course of bronchopneumonia, and not be recognized unless it becomes very extensive. *Respiration* is increased in frequency and is labored, being performed by the upper and anterior portions of the lung. The *pulse* is small, rapid, and feeble. The *skin surface*, especially of the extremities, is cool.

DIAGNOSIS.—Atelectasis is to be mainly differentiated from pulmonary embolism, pneumonia, and pleurisy.

Pulmonary Embolism.—In this disorder there is pain, bloody expectoration, and evidences of a febrile process that does not exist in atelectasis.

Lobar Pneumonia.—In the croupous form there is pain, marked crepitus, and high fever following chill. In atelectasis, however, we have a characteristic inspiratory retraction of the lower parts of the chest and smaller areas of dullness.

Pleurisy.—In this affection fever is also present; friction-sounds may be heard; percussion shows circumscribed area of flatness, shifting when the patient's position is changed.

This affection is very often met with in bronchopneumonia, especially in children.

ETIOLOGY.—Acquired atelectasis usually occurs as the result of a condition involving reduction of the lumen of the respiratory tract. For-

eign bodies may thus cause atelectasis by preventing the ingress of air, while the residual air is gradually eliminated by contractions of the thoracic walls and diaphragm, or absorbed. The bronchoscope (see LARYNGOSCOPY, BRONCHOSCOPY, etc., this volume) makes it possible to locate the foreign body in most cases and should always be resorted to.

False membrane, meconium, mucopurulent masses, blood, etc., have thus brought on this distressing condition. Processes that interfere with expansion of the chest by pressing on the lung—spinal curvature and other diseases of the bony framework, tumors, effusions into the pleural or pericardial cavities, great cardiac hypertrophy, aneurism, etc.—may also bring on atelectasis.

Abdominal tumors, excessive meteorism, and ascites may exert sufficient upward pressure against the diaphragm to compress the lower lobes of the lung. Any condition that weakens and obstructs the inspiration may cause this condition, such as certain cerebral disorders, pneumogastric paralysis, and paralysis of the chest walls. Thoracic deformities, such as pronounced kyphoscoliosis and the so-called "aplasia of the lungs," may produce pulmonary atelectasis. Kyphoscoliosis rarely causes true atelectasis, especially if it arises in youth, owing to the natural retractility of the lung. It may, however, interfere with lung expansion and growth.

PATHOLOGY.—The atelectatic areas—though hepatized, "carnified," or firm—do not show histological change, barring, perhaps, slight dilatation of the vascular supply. Viewed through the pleura, the surface is

smooth, depressed, and of a bluish-red color; on section the affected area appears brownish red. The collapsed cavities, whatever be their size, can

occurs as a complication of capillary bronchitis. Pertussis and widespread bronchopneumonia may also occur as causes.

PROGNOSIS.—The prognosis varies according to the extent of the area involved. When small areas are atelectatic, recovery is usual, but extensive reduction of the respiratory capacity is seldom recovered from. When secondary to pertussis and extensive bronchopneumonia, it is very fatal. When due to compression by pyopneumothorax, tumors, etc., the prognosis is grave. In premature births the chances are greatly against the infant. The same is the case when atelectasis is the result of some pulmonary disorder.

Complications, especially pulmonary tuberculosis, pleurisy, and bronchopneumonia, are frequently observed in these cases and greatly compromise the issue. When atelectasis is due to pressure,—i.e., occurs as the result of effusions into the pleura, aneurism, tumors, etc.,—the prognosis is very unfavorable. Emphysema sometimes presents itself in atelectatic infants, but, as a compensating factor, its presence increases the respiratory area.

Atelectasis due to foreign bodies is no longer as fatal as it used to be before the introduction of the bronchoscope, which in many instances makes it possible to locate the foreign body and to remove it.

TREATMENT.—The treatment is that of the primary disease. *Capillary bronchitis*, generally followed by collapse of the lobules, demands close attention; prophylactic measures are of prime importance. The patient should practise **deep breathing at regular intervals**; his **position in bed**



Method of resuscitation. (Dew.)

always be inflated with a blowpipe, as shown by Legendre and Bailly. The affected parts are non-crepitant, sink in water, and are resistant under section. When causative disorders are present, the post-mortem evidences vary accordingly.

Collapse of the lobules sometimes

should be **frequently changed** so as not to lie in one position too long. A valuable prophylactic measure is a **stream of cold water** applied over the **neck**. The inhalation of **compressed air** has given good results.

In *kyphoscoliosis* **tepid baths** do good. The heart condition requires close attention, and **cardiac stimulants** are demanded by the first loss of compensation or when we are unable to obtain compensation. An important indication in this disorder is to increase as much as possible the vital activity of the patient. **Gentle massage** under warm bedclothes, the friction being always in the direction of the heart, tends greatly to increase the activity of the circulation. Laborde's method of **rhythmical traction of the tongue** is said to be valuable. **Oxygen inhalations** would seem to be indicated, though care should be taken to avoid overstimulation, lest pulmonary hyperemia follow. **Pure air** is essential in such cases. A little **brandy**, a few drops in sugar and water, given from time to time, is generally recommended. Tonics—**strychnine** especially—are of value. **Nutritious**, though **easily digested food**, when the child is old enough, is of great importance as a curative factor to antagonize the vital adynamia that lies back of the trouble.

The following method of resuscitation has been advocated by Dew. The infant is grasped with the left hand, the neck resting between the thumb and forefinger (Fig. 1), the head falling far backward. The upper portion of the back and scapulae will rest in the palm of the hand, the other three fingers being inserted in the left axilla, raising it upward and outward. Next, the knees are grasped

(Fig. 2) so that the right one will rest between the thumb and forefinger, the left between the forefinger and middle finger. The back of the thighs will rest in the palm of the operator's hand. Next, the pelvis and lower extremities are depressed (Fig. 3), while the left hand gently bends the dorsal region of the spine backward. To excite expiration the movement should be reversed, the head, shoulders, and chest being brought forward and the ribs closed upon each other. At the same moment the thighs are brought forward and rested upon the abdomen.

Procedure based on that introduced by Schultze, but less dangerous. The infant is held vertically with the head down; the mouth and pharynx are freed from mucus. The cord is then tied, and the infant is placed in a sitting posture on a table, with the legs extended and separated; the physician takes up a position behind the infant, passes one hand into each axilla, the thumbs resting on the scapulae, and the other fingers applied to the front of the thorax; the trunk is then bent forward toward the angle between the separated legs, while, at the same time, the thorax is compressed by the operator's hands. The lungs are thus emptied. The body is now brought back into a horizontal position; the thorax expands, causing marked inspiration. Those movements of flexion and extension are repeated with the same frequency as the normal rhythm of respiration in the newborn. This method used for the past two years, and has never failed. Even in cases of pronounced asphyxia about a dozen of those movements have sufficed to revive the infant. Min-kévitch (*Semaine médicale*, No. 45, 1902).

PNEUMONOKONIOSIS.

DEFINITION AND VARIETIES.

—This is a term applied to the pro-

liferative interstitial inflammation of various pulmonary structures caused by the continued inhalation of dusts of different kinds. The three principal forms of pneumonokoniosis are *anthracosis*, or coal-miners' disease, due to the inhalation of coal-dust; *chalicosis*, or stone-cutters' phthisis, brought on by the inhalation of mineral dusts, and *siderosis*, due to the inhalation of iron oxide and other metallic particles. Clinically, pneumonokoniosis may be considered as a combination of chronic bronchitis, emphysema, and phthisis, which not infrequently assumes the tuberculous type.

SYMPTOMS.—The manifestations of the three forms of pneumonokoniosis are practically similar. Three stages may be distinguished. During the first there is general uneasiness, anorexia, loss of flesh, paroxysmal cough, and expectoration, varying to a degree, in color, with the kind of dust inhaled. In anthracosis the sputa are black, in chalicosis they are grayish black, while in siderosis they are red. In all three forms hemoptysis usually occurs, but this symptom is more frequently observed and the hemorrhages are likely to be more copious in chalicosis. Auscultation shows that the vesicular breathing murmur is lessened during this stage, while vocal resonance is enhanced; sibilant râles are usually detectable. The signs of chronic bronchitis become clearly defined during the second stage, and dyspnea and vomiting are now added to the symptoms already outlined. The sputa not only show their characteristic coloring, but they become mucopurulent, while the hemoptyses become relatively more frequent and copious. Symptoms of emphysema are now

superadded, and the dyspnea becomes asthmatic in character. The third stage is characterized by rapidly increasing anemia; cavities may then usually be detected, along with all the symptoms of pulmonary tuberculosis, with all its attending manifestations, night-sweats, diarrhea, hectic fever, intense dyspnea, and copious expectoration in which the tubercle bacillus is often found, and the patient succumbs. The third stage may not be reached, however, if the patient is relieved of the exposure to the causative elements in time; on the other hand, the usual manifestations may be replaced by those of some other local disease, particularly lymphosarcoma or other malignant growths of the lung.

An acute form of pneumonokoniosis due to the inhalation of phosphate meal has been reported. A diffuse pneumonia affecting principally the lower lobes occurs, the symptoms and prognosis of which are those of lobar pneumonia.

ETIOLOGY.—Anthracosis not only occurs among coal-miners, but also among laborers who inhale much coal-dust. Molders of bronze, iron, and copper also suffer when coal-dust is employed by them. Chalicosis is observed among stone-cutters, knife- and axe-grinders, mill-stone makers, and potters particularly. Siderosis occurs in those who inhale iron filings and the oxide of iron, polishers, gold-beaters, dyers, blacksmiths, and other crafts in which iron is more or less utilized. It is observed also among those who inhale vegetable dust, as in grain-shovelers, cotton-spinners, cigar-makers, etc.

PATHOLOGY.—The inhalation of air thickly laden with the foreign

agents mentioned, after a prolonged period of exposure, gradually weakens and finally overcomes the physiological functions calculated to protect the bronchial mucosa. The ciliated epithelium, the phagocytes, and the mucous and alveolar cells represent many structures upon whose integrity these functions depend. When these cannot be performed, the mucous membrane of the respiratory tract is penetrated and the foreign bodies invade the lymph-spaces, which represent a second barrier and are capable of disposing of comparatively enormous quantities of intruding substances. When this line of defense is overcome, however, many particles are carried to the lymph-nodes surrounding the bronchi and the blood-vessels and to the interlobular septa under the pleura, where they accumulate between the tissue-elements, and, through the larger lymph-channels, to the substernal, bronchial, and tracheal glands, in which the stromacells of the follicular cords dispose of them permanently and prevent them from entering the general circulation (Arnold, quoted by Osler). When the pigmented bronchial glands become adherent to the pulmonary veins, however, the foreign particles may invade the general circulation and be found in remote organs, the liver and spleen especially (Weigert).

When the limit of tolerance is reached, an interstitial sclerosis begins in the bronchial glands and periarterial lymph-nodes. These gradually harden, and coalesce until large fibroid areas—cirrhotic masses—are found in various parts of the organ. *Post mortem*, such masses, when cut, are quite resistant, and sink in water and color it black. The fingers of the

operator become blackened likewise, the cut surfaces appearing either black or marble-like. The bronchi are seldom found dilated, but the finer arterial supply is often obliterated, and cavities containing a dark fluid are formed, mainly through the arrest of nutrition. When the latter communicate with the bronchi their walls usually ulcerate. The pleura is often thickened and lesions of the right heart are often observed (Dieulafoy).

A study of 234 cases of miner's consumption among zinc miners in western Missouri, showed that it is widely prevalent among the hard-rock miners of the Joplin district, affecting probably 30 to 35 per cent. of them. It is essentially a pneumoconiosis, due to the inhalation of silicious rock dust, and resulting in a fibrosis, with loss of function. The disability, etc., are due primarily to silicosis, infection being usually a secondary, and often a terminal process. Infection, both tuberculous and pyogenic, is common, the tendency to infection increasing as the disease progresses. The incidence of tubercle infection in miner's consumption is a menace to public health, Lanza (*Public Health Bull. No. 85, Jan., 1917*).

TREATMENT.—Unless removal to hygienic surroundings early in the history of the case can be carried out, pneumoconiosis progresses steadily. Anthracosis advances slowly, but chalicosis is usually fatal after three or four years. In siderosis the duration of life is somewhat longer. If the patient cannot be removed elsewhere and finds himself obliged to continue his occupation, the wearing of appropriate **masks** or **respirators** may stay the progress of the disease. **Free ventilation** of shops, mines, etc., is also prophylactic in this particular; but total **change of occupation** is

the only absolute protective. The disease is often arrested when this can be done. **Iodide of potassium**, and the measures indicated in chronic bronchitis (*q.v.*) and emphysema (*q.v.*) from other causes, have given excellent results when hygienic surroundings are within the reach of the patient. When pulmonary tuberculosis develops, the treatment must be modified to meet the new conditions.

The writer has been using **fibrolysin** (a chemical combination of sodium salicylate and thiosinamine, the latter being formed by warming oil of mustard with alcoholic solution of ammonia) in the treatment of miners' phthisis, and was uniformly successful in ameliorating the symptoms. The improvement is shown after the third or fourth injection and is evidenced by a feeling of less discomfort on the part of the patient, less cough, and freer expectoration. The patient generally sleeps longer and more comfortably and eats better. At the end of six weeks he looks decidedly better and loses the pinched, blue expression. He becomes able to speak a long sentence without a pronounced break, and is not forced to keep his mouth open to breathe.

The writer used Mendel's preparation in ampullæ of 2.3 c.c. (35 minims), roughly, three times a week. Given hypodermically, it is practically painless: it may be used orally and intravenously, but with disadvantage. Some patients have a peculiar taste, lasting for twelve hours. F. B. Counihan (Transvaal Med. Jour., May, 1913).

SYPHILIS OF THE LUNGS.

SYMPTOMS.—The symptoms of this condition are either those of a simple bronchial catarrh or are suggestive of pulmonary tuberculosis, such manifestations as fever, expectoration, copious sweats, and loss of

weight being noted. Areas of dullness, with bronchial breathing and increased vocal resonance, are likely to be found, and the prolonged course of the affection is likewise suggestive of tuberculosis.

ETIOLOGY AND PATHOLOGY.

—The condition, which is due to *Spirochæta pallida*, is an uncommon one, except in its congenital form. In the secondary stage of syphilis the pathological state present is merely one of catarrhal inflammation of the bronchi. In the more frequent cases occurring in the tertiary (or late secondary) stage gummatous infiltration of the submucous tissue of the trachea and bronchi is not uncommon. In the lung-tissue itself gummata may also occur, singly or in numbers, and ranging in size from that of a hemp seed to that of a goose egg. Such lesions occur oftenest in the interior portions of the lung and at the bases, the latter being a feature distinctive of syphilitic as against tuberculous lung disease. Syphilitic bronchopneumonia is a possible condition, and fibroid changes have been ascribed to syphilis as follows: (1) Thickening extending from the hilus around the bronchi and vessels; (2) isolated masses of fibroid tissue in various parts of the lung; (3) diffuse changes occupying the greater part or the whole of the lung (Roussel). White radiations extending from the gummata out into the neighboring tissues have been noted.

DIAGNOSIS.—In the early stages distinction between lung syphilis and tuberculosis is extremely difficult. Later, the continued absence of tubercle bacilli from the sputum, the negative tuberculin (von Pirquet) test, and especially the prompt favorable effect of antisyphilitic treatment

will prove significant. If no tubercle bacilli appear in the sputum after administration of iodides, the presence of a condition other than lung tuberculosis may be strongly suspected.

Other diseases which must be thought of in the differential diagnosis are tumor of the lung and blastomycosis.

TREATMENT.—The measures customarily employed in syphilis—**mercury, potassium iodide**, and, on occasion, **salvarsan**—are indicated in these cases, and under their use the symptoms rapidly disappear.

BRONCHOPULMONARY SPIROCHETOSIS.

The war has emphasized the importance of this disease, first described by Castellani in 1908. Thus Violle (*Bulletin de l'Acad. de Méd.*, June 4, 1918) alone observed 30 cases in a naval hospital. The most striking feature of the disease, which is due to the spirocheta bronchialis, was the constant reddish coloration of the sputum, due to blood, and causing the fluid to resemble currant juice. This peculiarity is in itself pathognomonic, and occurred in every case of the author's series. Half the cases had been diagnosed as tuberculous, but tubercle bacilli were never found, while smears stained with silver nitrate by the method of Fontana, as modified by Tribondeau, showed innumerable spirochetes of varied sizes and shapes, often with practically no other bacterial accompaniment. These spirochetes do not occur in the nasal mucus, urine, nor blood. The Bordet-Wassermann reaction is negative. The affection begins insidiously, and the signs are those of ordinary bronchitis or at times of apical bronchitis or of basal congestion. Cough is frequent, raucous, and chiefly nocturnal. The general condition remains good and

there is no fever, and but slight headache. The affection runs its course in an average period of one month, but relapses are frequent. It is mainly dangerous because it favors tuberculosis, pneumonia, and bronchopneumonia, the germs of which enter the lung tissue at the points of bleeding. This danger is transmitted to other individuals by spirochete carriers. Thompson has observed some cases simulating tuberculosis and others malaria.

TUMORS OF THE LUNGS.

The lungs are subject to involvement by carcinoma, sarcoma, adenosarcoma, subpleural enchondroma, myxoma, osteoma, fibroma, and dermoid growths. In the great majority of cases of malignant tumor the growth is secondary.

SYMPTOMS.—Among the chief symptoms of malignant lung involvement are cough, expectoration, pain, and swelling of the arms and a livid aspect of the face, due to obstruction of vessels by the tumor. Dark, reddish sputum and fever are symptoms the result of a pneumonic process taking place as a reaction around the seat of malignant invasion.

Difficulty of breathing, sometimes marked, may result from pressure of the tumor mass or masses on the trachea or bronchi, aphonia from compression of the vagus or recurrent laryngeal nerves, and even the heart itself be displaced. The physical signs of pneumonia may be elicited upon percussion and auscultation, and signs of pleurisy may also exist. Cachexia supervenes and terminates in death, generally in eight months, unless encroachment on the vessels or the respiratory passages has already caused an acute fatal ending at an earlier period.

In the presence of benign tumors of the lung the symptoms are similar, with the exception that cachexia is absent and exitus delayed.

PATHOLOGY.—The commonest tumor condition in the lungs consists in the presence of a number of whitish nodules of carcinoma or sarcoma, about $\frac{1}{2}$ inch in diameter, disseminated in one or both organs. The primary seat of malignant disease in these cases is usually the breast, and, correspondingly, secondary lung tumor is commoner in the female than in the male sex, whereas in the case of primary lung tumor the two sexes are affected with approximately like frequency.

Primary carcinoma of the lung may be either medullary, scirrhus, epitheliomatous, melanotic, or colloid in type, and generally occurs in the posteroexternal portion of the upper pulmonary lobe in the form of a whitish nodule ranging in size from that of a plum to that of a large orange. The bronchial glands and pleura may be secondarily involved from this type of tumor, or the growth may be peribronchial from the outset, occurring in nodules of varying size dispersed along the bronchi and bronchioles, and leading also to involvement of the lymph-nodes at the pulmonary hilus.

DIAGNOSIS.—This is made from observation of the symptoms already mentioned, persistence of such manifestations over a long period being suggestive, especially if a primary growth is known to be present elsewhere. The supra- and infra-clavicular lymph-nodes may be significantly enlarged.

The writer emphasizes the value of the following features of malignant lung disease in the diagnosis

thereof: 1. Early emaciation. Loss of flesh may begin two or three or even six months before local manifestations appear, especially in carcinoma. 2. Dyspnea, which may occur early and is often more marked than would seem warranted on comparison with the apparent involvement in the chest. 3. The fact that little if any relief is obtained by tapping, probably, at least in some cases, because the fluid is contained in cysts or sacculations. 4. A characteristic type of hemoptysis, which the author has noticed three times in 7 cases of primary lung disease, and several times in pulmonary metastases, but never in any other affection, and which he believes to be pathognomonic. It consists in the expectoration of a dark-purple or red globule of blood encased in a transparent glazed coating or capsule and about the size of the end of the little finger. It is sometimes lobulated. Roland G. Curtin (Monthly Cyclo. and Med. Bull., Dec., 1912).

TREATMENT.—Symptomatic treatment is alone possible in tumor of the lung. The patient should be rendered comfortable by the use of narcotic drugs, curative measures not being now available.

CHARLES E. DE M. SAJOUS,
Philadelphia.

LUNGS, INJURIES AND SURGERY OF. See CHEST, INJURIES AND SURGICAL DISEASES OF.

LUPULUS (HUMULUS, U. S. P.) AND LUPULIN.—Lupulus, or hops, consists of the carefully dried strobiles, or fruit, of *Humulus lupulus*, of the family Moraceæ, bearing their natural glandular powder (trichomes). The glandular powder, or *lupulin*, detached from the hops by sifting, occurs as a bright, light-brownish-yellow (becoming yellowish brown), mobile, granular, resinous powder, having a strong odor of hops and a strongly aromatic and bitter taste. It is of low specific gravity, and floats on water.

Lupulin contains a brownish-yellow fluid, which dries to a resinous mass. It yields a tasteless resin, a wax known as *myricin* (myrocyclic palmitate), and the bitter *lupamaric* or hop-bitter acid.

PREPARATIONS AND DOSE.—The official preparations are the following:—

Humulus, U. S. P. (hops). Dose, 30 grains (2 Gm.).

Recognized in the National Formulary are:—

Lupulinum, N. F. (lupulin), soluble in ether to the extent of 60 per cent. Dose, 3 to 15 grains (0.2 to 1 Gm.).

Fluidextractum lupulini, N. F. (fluid-extract of lupulin). Dose, 5 to 20 minims (0.3 to 1.25 c.c.).

Oleoresina lupulini, N. F. (oleoresin of lupulin), made by percolation of lupulin with acetone and evaporation. Dose, 2 to 5 grains (0.12 to 0.3 Gm.).

Fluidextractum humuli, N. F. (fluid-extract of hops). Dose, 30 minims (2 c.c.).

Elixir humuli, N. F. (elixir of hops). Dose, 2 fluidrams (8 c.c.).

THERAPEUTICS.—Lupulin and humulus are believed to possess some hypnotic power, and are employed for purposes of nervous sedation in the treatment of **hysteria**, **insomnia**, general **nervousness**, and even **delirium tremens**. Their continuous use does not appear to be followed by any undesirable after-effects.

Stern has found lupulin of special value in the **functional disturbances** of the **gastrointestinal tract**, including sensory as well as motor and secretory neuroses, **nervous anorexia**, **hyperesthesia** of the **gastric mucosa**, and **cardialgia**. He prescribes lupulin in 5-grain (0.3 Gm.) capsules half an hour before meals, either alone or in conjunction with berberine

phosphate, capsicin, silver nitrate, mono-bromated camphor, iron and strychnine citrate, nux vomica, cinchonidine sulphate, etc., according to indications. In **intestinal neuroses** lupulin, in doses one-half again or twice as large as used for the stomach, also proved useful in Stern's hands.

Hop tea, consisting of an infusion of $\frac{1}{2}$ ounce (15 Gm.) of hops in a pint (500 c.c.) of boiling water, has proved useful at times in **flatulence**, mild **diarrhea**, and **atonic gastric states**. Given in doses of $\frac{1}{2}$ to 1 wineglassful before meals, it acts as a stomachic.

In **irritation of the kidneys** or **bladder**, and in **priapism**, lupulin appears to have been of some utility. W. and S.

LUPUS ERYTHEMATOSUS.

See TUBERCULOSIS OF THE SEROUS MEMBRANES AND SKIN.

LUPUS VULGARIS. See TUBERCULOSIS OF THE SEROUS MEMBRANES AND SKIN.

LYCETOL. See PIPERAZIN.

LYMPH-GLANDS, INJURIES AND DISEASES OF. See THYMUS, LYMPHATICS, AND MEDIASTINUM, DISEASES OF.

LYMPHANGIECTASIS. See THYMUS, LYMPHATICS, AND MEDIASTINUM, DISEASES OF.

LYMPHANGIOMA. See THYMUS, LYMPHATICS, AND MEDIASTINUM, DISEASES OF.

LYSIDIN. See PIPERAZIN.

LYSOL. See TAR.

M

MADURA FOOT.—A condition of the foot produced by the invasion of its tissues by *Streptothrix madura*, usually through a scratch or abrasion of the skin, causing enlargement, deformity and finally destruction of the member.

SYMPTOMS.—After an incubation period of from ten to thirty days following the cut or injury, pain or swelling appears at the site of the primary lesion, which swelling becomes hard and a bleb forms on the surface,

which bursts and leaves a small opening, discharging an oily, rarely sanious, thin, offensive pus, in which are the granules characteristic of the fungus. The dorsum of the foot becomes studded with nodules and openings, which latter lead into sinuses penetrating deeply into the tissues, even into the bones. The disease has no tendency to heal, and the patient dies from exhaustion or diarrhea after from ten to twelve years.

Three varieties are to be distinguished clinically, the yellow or ochroid, the black, and the red, named from the color of the granules found in the discharge. The ochroid is the most common, the red the least.

TREATMENT.—Prophylaxis consists in **guarding against wounds** from pieces of wood, stones, thorns, etc., by **wearing sandals, shoes, or boots**. Any wounds received should at once be thoroughly **cleansed, carefully dried, and then mopped with tincture of iodine**.

The treatment proper is surgical, and consists of **curetting** or **excision** if the process be localized; otherwise of **amputation** through healthy tissues. W.

MAGNESIUM.—Magnesium is a metal of the alkaline earth group, light and having the appearance of silver. When rolled in thin plates or ribbons, magnesium can be ignited, and burns with a brilliant, white flame, giving off a dense white smoke, which consists of the oxide of magnesium. The metal is not used in medicine, but the oxide and various salts are official.

PREPARATIONS AND DOSE.—

Magnesium oxidum, U. S. P. (magnesium oxide; magnesia; light magnesia; calcined magnesia) $[MgO]$, occurs as a very light, bulky, fine, white powder, with a slight earthy taste, and slowly absorbs moisture and carbon dioxide on exposure to the air. It is almost insoluble in water, and insoluble in alcohol, but dissolves in dilute acids. When moistened and

placed in contact with red litmus paper it exhibits a faintly alkaline reaction. Stirred with 15 parts of water and allowed to stand half an hour, it forms a gelatinous mass of magnesium hydroxide. Dose, 5 to 60 grains (0.3 to 4 Gm.); official average dose, 30 grains (2 Gm.).

Magnesium oxidum ponderosum, U. S. P. (heavy magnesium oxide; heavy magnesia; Husband's magnesia) $[MgO]$, occurs as a heavy, fine, white powder, with the same properties as the preceding except that it fails readily to unite with water to form a gelatinous hydroxide. Dose, as of the preceding.

Magnesium carbonas, U. S. P. (magnesium carbonate) $[approximately (MgCO_3)_4 \cdot Mg(OH)_2 + 5H_2O]$, occurs in light, white, friable masses or a bulky, white powder, with a slight earthy taste, and permanent in the air. It is practically insoluble in water, more soluble in carbon dioxide water, insoluble in alcohol, but soluble in dilute acids. When strongly heated it is converted into magnesium oxide. Dose, 5 to 120 grains (0.3 to 8 Gm.); official average dose, 45 grains (3 Gm.).

Magnesium sulphas, U. S. P. (magnesium sulphate; Epsom salts; bitter salt) $[MgSO_4 + 7H_2O]$, occurs in small, colorless needles or rhombic prisms, with a cooling, saline, and bitter taste, soluble in 0.85 part of water at 25° C. and in 0.13 part of boiling water, but insoluble in alcohol. Dose, 1 dram to 1½ ounces (4 to 48 Gm.); official average dose, 4 drams (16 Gm.).

Magnesium sulphas effervescens, U. S. P. VIII (effervescent magnesium sulphate), contains approximately one-half its weight of magnesium sul-

phate, and is made from 500 parts of magnesium sulphate crystals, 403 parts of dried sodium bicarbonate, 211 parts of dried tartaric acid, and 136 parts of citric acid crystals. Dose, 4 drams (16 Gm.).

Liquor magnesi citratis, U. S. P. (solution of magnesium citrate), is made by dissolving 33 Gm. (500 grains) of magnesium carbonate in 120 c.c. (4 fluidounces) of water, adding 15 Gm. ($\frac{1}{2}$ ounce) of magnesium carbonate, stirring until dissolved, filtering into a 360 c.c. bottle containing 60 c.c. (2 fluidounces) of syrup of citric acid, adding enough water nearly to fill the bottle, dropping in 2.5 Gm. (38 grains) of potassium bicarbonate, and stoppering the bottle, which is to be shaken occasionally until the potassium bicarbonate is dissolved. Dose, 12 fluidounces (360 c.c.).

Infusum sennæ compositum, U. S. P. (compound infusion of senna; black draught). For ingredients see SENNA. Dose, 4 fluidounces (120 c.c.).

Pulvis rhei compositus, U. S. P. (compound rhubarb powder). For ingredients see RHUBARB. Dose, $\frac{1}{2}$ dram (2 Gm.).

Ferri hydroxidum cum magnesi oxido, U. S. P. (ferric hydroxide with magnesium oxide). For ingredients see IRON. Dose, 4 fluidounces (120 c.c.).

Magma magnesicæ, U. S. P. (milk of magnesia), is made by treating a mixture of magnesium carbonate and water with sodium hydroxide, and contains as a suspension in water 7 per cent. of magnesium hydroxide in a finely divided state. Dose, $2\frac{1}{2}$ fluidrams (10 c.c.).

Liquor magnesi sulphatis effervescens, N. F. (effervescent solution

of magnesium sulphate), contains in 12 fluidounces (350 c.c.) 6 drams (25 Gm.) of magnesium sulphate. Dose, 12 fluidounces (350 c.c.).

Pulvis rhei et magnesie anisatus, N. F. (compound anise powder). For ingredients see RHUBARB. Dose, for infants, 5 grains (0.3 Gm.).

PHYSIOLOGICAL ACTION.—

Locally, strong solutions of magnesium salts have been shown experimentally by Wiki to possess distinct local anesthetic power. Injected into the skin of guinea-pigs, a saturated solution of magnesium sulphate containing 0.62 Gm. of the salt in each cubic centimeter produces complete local anesthesia, generally persisting over an hour. Superficial inflammations of various kinds are, moreover, attenuated or inhibited by local application of concentrated magnesium sulphate solutions; the reason for this, however, is at yet obscure.

Whereas solutions of sodium sulphate and sodium chloride approximately isotonic with the body fluids have no anesthetic power, magnesium sulphate solutions of the same molecular concentration (about 7 per cent.) produce distinct local anesthesia. A solution of magnesium chloride of 5 per cent. strength was found to produce anesthesia of short duration; 7 to 10 per cent. solutions produced insensibility lasting somewhat over half an hour. B. Wiki (Archives intern. de pharm. et de therap., vol. xxi, Nos. 5-6, 1912).

Introduced into the intestine, soluble magnesium salts, in particular the sulphate, exert a purgative effect probably by drawing water from the surrounding tissues through osmotic action as well as by preventing the absorption of water already present in the canal and of that introduced with the salt itself. The excessive

fluid content of the bowel then causes rhythmic intestinal segmentations (Cohnheim), which in the course of one or a few hours result in the passage of one or more watery stools; some of the solids in the intestine, however, are apt to remain behind, and therefore a saline cathartic such as magnesium sulphate may not cleanse the bowel as thoroughly as a more slowly acting vegetable cathartic that will directly excite peristalsis (Bastedo). In the stomach strong solutions of magnesium sulphate are somewhat irritating and tend to produce nausea; this effect can, however, be largely obviated by administration of the salt in an effervescent drink. In contrast to what occurs after the administration of sodium sulphate, the purgative effect of magnesium sulphate seems to increase when the same dose is repeated several days in succession.

General Effects.—*Nervous System.*

—While little or no systemic effect of the ion magnesium is obtained when a magnesium compound (unless in concentrated solution) is taken by the mouth, the metal is by no means devoid of specific toxic properties, as was pointed out by Meltzer and his associates upon experimental administration of magnesium salts by parenteral routes. Injected subcutaneously, intravenously, or intraspinally, solutions of magnesium salts cause a gradually oncoming motor paresis, eventuating in complete muscular relaxation and general anesthesia. If the intoxication be further slightly augmented respiratory depression appears, and death may take place through failure of this function. These effects are ascribed to a paralyzing action of the drug on nerve-

endings, probably beginning with those of the motor nerves to striped muscle tissue (a curare-like action), but soon after involving also the sensory.

Circulation.—Magnesium salts, when present in the circulation, tend to depress the heart—in particular, the cardioaccelerator nervous mechanism, according to Matthews and Brookes. Death takes place, however, not from circulatory, but from respiratory, paralysis (peripheral). If life is maintained by artificial respiration, depression of the vasomotor center is likely sooner or later to follow.

Alimentary Tract.—That magnesium sulphate injected subcutaneously or intravenously will at times induce purgation suggests that the cathartic effect of the drug may be due not alone to osmotic action in the bowel, but to a direct stimulating effect on peristalsis. Experimental results in this connection have been conflicting. That some peristaltic stimulation occurs from small amounts cannot as yet be considered to have been disproved. Large amounts absorbed into the blood are known to paralyze the bowel.

In the purgative effect of magnesium sulphate both the magnesium and sulphate ions are active. With magnesium oxide, hydroxide, and carbonate, on the other hand, the magnesium ion alone is active as a purgative, their action being, therefore, less marked. These salts, however, act in addition as non-caustic alkalies. The gelatinous hydroxide of magnesium will saturate $1\frac{1}{2}$ times its weight of official hydrochloric acid.

Absorption and Elimination.—Though not absorbed to any significant extent from the bowel under

ordinary circumstances and as ordinarily administered, magnesium sulphate is in part absorbed when given in a concentrated solution or in dry form, or, where there is intestinal paresis, even in dilute solutions, causing general systemic depression. By whatever route introduced into the circulation, magnesium salts are eliminated to a great extent through the kidneys.

When soluble magnesium compounds are introduced into animals by another route than the gastrointestinal tract, the greater portion of the excess injected leaves the body through the kidneys in less than forty-eight hours. The intestinal path is of minor, if any, significance. A considerable quantity of magnesium may be retained in the body for periods exceeding two weeks. The increased excretion of magnesium by the kidneys is accompanied by a marked rise in the urinary output of calcium. Parenteral introduction of magnesium sulphate in dogs and rabbits is never followed by purgation. Diuresis, however, occurs. L. B. Mendel and S. R. Benedict (*Amer. Jour. of Physiol.*, Sept., 1909).

UNTOWARD EFFECTS AND POISONING.—Where sufficient absorption of magnesium into the system occurs, signs of poisoning, at times very serious, will inevitably develop. Of 10 cases of poisoning reported by Boos, 6 resulted in death. The symptoms closely resemble those witnessed in experimental poisoning of animals, and include motor weakness in the limbs, difficult respiration, mydriasis, vomiting in about one-half the cases (Boos), convulsive phenomena in occasional instances, coma, oliguria, slowing and weakening of the heart action, and death from respiratory failure. Burning pains in

the abdomen may have been experienced through local irritation by the salt taken.

Report of 10 cases of poisoning from magnesium sulphate. In 7 there was no effect. The salt, on the other hand, seemed to cause a paralysis of the bowel, so marked in 2 cases that laparotomy was performed. A marked diminution of the urine also occurred, amounting in some almost to anuria. In only 1 case was there active purging. This patient had taken the salt in several pints of beer. Convulsions and motor paralysis were observed in 2 cases. Striking depression of respiration occurred in 6 cases. Boos (*Jour. Amer. Med. Assoc.*, vol. lv, 2038, 1911).

Magnesium sulphate given by mouth as a laxative is often followed by considerable depression, particularly if it fails to cause the bowels to move. The author used the drug as a laxative in a number of children. In nearly every case it was followed by more or less marked depression. LeGrand Kerr (*L. I. Med. Jour.*, Mar., 1914).

In most cases of poisoning catharsis has failed to take place, the salt being instead absorbed from a concentrated solution. Urine into which it is being excreted not infrequently shows a very high specific gravity—1.070 or even 1.080.

In the absence of hydremia the tendency of magnesium sulphate to be absorbed increases with the concentration of the solution, the dry salt being completely absorbed without action on the bowels. In hydremic conditions, however, the salt, even when given in very concentrated solution, is not absorbed. It appears, therefore, that the practice of giving very concentrated solutions of magnesium sulphate to deplete the system of excessive water is rational, but perhaps not without possible danger. In the absence of edema or

ascites the object of giving magnesium sulphate can be none other than to produce efficient catharsis. To obtain this without danger of intoxication, the salt is best given in solutions not exceeding 6 per cent. in strength. Above this concentration more or less magnesium sulphate is absorbed and is lost to catharsis, while its presence in the circulation is a menace to the patient's life. In the Massachusetts General Hospital the patients are given $\frac{1}{2}$ ounce (15 Gm.) of magnesium sulphate dissolved in 3 fluid-ounces (90 c.c.) of water, to be followed immediately by a glass of water. Boos (Boston Med. and Surg. Jour., July 22, 1909).

On account of the slowness of its excretion from the system magnesium sulphate is capable of producing poisoning by the cumulative action of small doses, given repeatedly in concentrated solution (Boos).

In several of the cases of fatal poisoning the amount of magnesium sulphate taken had been only 1 ounce (30 Gm.). At autopsy the most typical findings are patches of reddening on the gastrointestinal mucous membranes.

Treatment of Magnesium Poisoning.—Boos advises that in cases of suspected magnesium poisoning copious **intravenous saline infusions** be given. Dilute solutions of **calcium salts** given hypodermically may also prove of benefit. (Intravenous injection of a solution of calcium chloride in animals poisoned with magnesium sulphate frequently causes almost instantaneously a marked improvement in motor power.) **Physostigmine** (eserine) might likewise be of some use, Meltzer and Joseph having demonstrated the antagonistic action of magnesium sulphate and this drug on the nerve-endings in striped muscle.

Stimulants such as **ammonia**, **ether**, **atropine**, **cocaine**, **strychnine**, and **digitalis**, as well as **external heat**, are also indicated in these cases.

Case of poisoning in a boy $3\frac{1}{2}$ years of age who took a heaping spoonful of Epsom salts, thinking it to be sugar. A few minutes later he was found with pain in the stomach, nausea and retching, thirst and vomiting. When seen twenty-five hours later he was critically ill, lying on his back, with face pinched, eyes sunken, and skin pale. The mind was clear. There were intermittent colicky attacks. Temperature, 100.5° F.; pulse, 160 and small; tongue dry, with prominent papillæ; thirst intense, and the bowels had not acted. Half an ounce of urine had been passed in twenty-four hours. The abdomen was distended and rigid, and the skin markedly hyperæsthetic. The catheter withdrew half an ounce of dark, muddy, very acid urine, containing no albumin. The symptoms getting worse and suggesting acute peritonitis, laparotomy was performed. About 2 pints of blood-stained serum, subsequently found sterile, were withdrawn. No cause for obstruction was found. For forty-eight hours the child seemed moribund. Subcutaneous **saline injections** were made, and $\frac{1}{2}$ grain (0.03 Gm.) of **calomel** given every hour. Finally flatus and feces passed, the bowels opened, and recovery ensued. Fraser (Lancet, Apr. 24, 1909).

THERAPEUTICS.—As **antacids** magnesium oxide, heavy magnesium oxide, and magnesium carbonate are used. Of these, the heavy oxide would seem to be, perhaps, the best. The light magnesia has the disadvantage of being bulky in sufficient doses, and magnesium carbonate is apt to give rise to flatulence on account of the carbon dioxide gas given off when it is subjected to the action of the acid of the gastric juice. The latter

objection, however, does not always hold, since the stimulating action of the carbon dioxide gas upon the mucous membrane of the stomach is at times beneficial, the drug acting as a sedative and anodyne in the treatment of **indigestion** with **sick headache** or **pyrosis**. In **diarrhea** from indigestion, with acid stools, magnesium oxide combined with rhubarb yields very satisfactory results.

Magnesium oxide, being free from taste and non-irritating, is a very desirable remedy for children. The carbonate, combined with carminatives, is especially useful in the **flatulent colic** and **diarrhea** of infants. Demers's formula is:—

℞ *Magnesium carbonate* 3ss (2 Gm.).
Tincture of asafetida gtt. xl.
Tincture of opium .. gtt. xx.
Sugar 3j (4 Gm.).
Distilled water f3j (30 c.c.).—M.

The dose is $\frac{1}{3}$ to 1 teaspoonful, according to age.

The antacid properties of magnesium oxide render it valuable as an antidote in cases of **poisoning by the strong mineral or vegetable acids**. Besides neutralizing the acids, it acts as a mechanical protective to the tissues against their corrosive action. Its value as an antidote in **poisoning by metallic salts** depends upon the fact that it precipitates many metals from their acid of combination, thus rendering the metal less poisonous. In **poisoning by arsenic** freshly prepared magnesium hydrate is an antidote of no mean value, though it is not so effective as the official hydrate of iron with magnesium oxide, of which doses of 1 to 4 ounces (30 to 120 Gm.) are given.

As purgatives magnesium oxide and carbonate are often used in children.

In adults the neutral salts, the citrate and sulphate, are more generally employed. The oxide and the carbonate are hardly suitable for continuous administration, as, being insoluble, they may accumulate in the intestines and form concretions of the hydrate of magnesium. Magnesium citrate and sulphate cause little, if any, irritation, and are on that account valuable as laxatives in **enteritis**. A rather free ingestion of water at the time of administration assists their action. In **intestinal putrefaction** they are also of decided utility. In **febrile affections**, given in small doses, they exert a refrigerant and a slight diuretic action. Combined with iron, they are useful in **constipation** associated with atonic conditions. In **anemia** and **chlorosis** the following mixture is not infrequently useful as a tonic laxative:

℞ *Magnesium sulphate* 3j (30 Gm.).
Potassium bitartrate 3j (4 Gm.).
Dried ferrous sulphate gr. x (0.6 Gm.).
Water Oij (1000 c.c.).—M.

Sig.: One wineglassful a half-hour before breakfast each morning.

The constipation of **lead poisoning** is relieved best by magnesium sulphate as follows:—

℞ *Magnesium sulphate* .. 3ij (8 Gm.).
Morphine sulphate .. gr. j (0.06 Gm.).
Peppermint water f3ij (90 c.c.).

M. Sig.: One tablespoonful every two hours in lead colic.

Culbertson asserts that the usual method of giving magnesium sulphate can be greatly improved upon by administering only $\frac{1}{2}$ to 1 dram (2 to 4 Gm.), dissolved, however, in a pint (500 c.c.) of water. The water aids in establishing increased peristalsis. The same dose given at bedtime acts well as a diuretic and stimulant to elimination through the skin. In

migraine magnesium sulphate should be given in doses of $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) at bedtime, dissolved in a goblet of warm water.

The purgative mineral waters (Friedrichshall, Püllna, Seidlitz, and Hunyadi) owe their purgative action principally to the presence of magnesium sulphate.

In **serous effusions** (pleural, peritoneal, etc.) magnesium sulphate in doses of 1 or 2 ounces (30 or 60 Gm.) daily yields good results, especially if the amount of fluids ingested be restricted. It may be given by enema if preferred, as proposed by Watkins:

℞ *Magnesium sulphate* ʒij (60 Gm.).
Glycerin fʒj (30 c.c.).
Water fʒiv (120 c.c.).—M.

Edema and anasarca, as in **Bright's disease**, are relieved in a similar manner by magnesium sulphate. It tends to relieve the congestion of the kidneys in general anasarca and is also of value in **edema of the lungs and brain**, and in **ascites**. In particularly asthenic cases it should be used with caution, as it is liable further to weaken and depress the patient. In **uremia** associated with constipation magnesium sulphate is a valuable remedy.

In 17 cases of **obstinate constipation** occurring in cases of **appendicitis, corrosive sublimate poisoning, acute articular rheumatism, pneumonia, valvular disease, gastric cancer**, etc., the authors made hypodermic injections of from 0.5 to 5 c.c. (8 to 80 minims) of a 25 per cent. solution of magnesium sulphate. Best results were obtained by injecting under the skin of the abdomen. Good bowel movements were obtained in 14 cases. A dose of from 0.5 to 1 c.c. (8 to 16 minims) was found most effective.

The authors advocate the pro-

cedure where purgation in the usual way is impossible, where rectal administration is ineffective, or where it is desirable to affect the intestinal musculature rather than the intestinal mucosa. Thus, it would appear to be of value in cases of **uremic coma, tonsillar abscess, intestinal paresis, intestinal obstruction**, and in patients who are unable to retain anything on their stomach. A. Robin and M. Sourdel (Bull. et mém. de la Soc. méd. des Hôp. de Paris, June 20, 1912).

Administration of magnesium sulphate is of assistance to **lessen the mammary secretion**, where this is desired, in nursing mothers.

Diarrhea due to fecal impaction is best relieved by small doses of magnesium sulphate given every hour. The drug is also useful in **dysentery**, combined with aromatic sulphuric acid and tincture of opium. In **acute dysentery** it will often overcome the fever and tenesmus, and remove the blood and mucus from the stools. Leahy has advised the use of the following: Saturate 7 fluidounces (210 c.c.) of water with a sufficient quantity of magnesium sulphate, and add 1 fluidounce (30 c.c.) of diluted sulphuric acid. Of this give a tablespoonful (15 c.c.) every hour or two in a wineglassful of water until it operates. Morphine may be added, or starch enemata with laudanum used.

In persistent **diarrhea** due to indigestion in cases of **tuberculosis** Robin recommends the following combination:—

℞ *Magnesii hydroxidi* ʒiiss (6 Gm.).
*Bismuthi subnitrat*is ... ʒss (2 Gm.).
Sodii bicarbonatis ʒij (8 Gm.).
Calcii carbonatis præ-
cipitati,
Sacchari āā ʒss (16 Gm.).

Pt. in chart. no. xxiv.

Sig.: One powder after each meal.

Magnesium carbonate is useful as an inexpensive substitute for bismuth in general practice. In many instances it is no less efficacious than the latter. N. Reader (Pract., Nov. 1912).

In **rectal disorders** magnesium sulphate in moderate doses is of great value, as it liquefies the fecal passages and renders them less irritating. In **cancer** or **stricture of the rectum**, **hemorrhoids**, and **fissure of the anus** this is very desirable. Magnesium sulphate, as well as other salines, will act painlessly upon the bowels of a patient fully under the influence of opium, which renders them especially useful in **atony of the rectum**.

The unpleasant taste of magnesium sulphate may be conveniently disguised by the addition of a small amount of fluidextract of licorice or by boiling it with or giving it in coffee. For general use 4 ounces (125 Gm.) of magnesium sulphate may be dissolved in 4 fluidounces (125 c.c.) of lemon or other syrup, and enough water added to make 1 pint (500 c.c.). Of this the dose is a wineglassful or two.

Magnesium salts abolish the tremor caused by eserine, and are of some value as antidotes in **eserine poisoning**, though they have no influence on eserine myosis. D. R. Joseph (Amer. Jour. of Physiol., Jan., 1909).

Intravenous injections of magnesium sulphate found very beneficial in 6 cases of **puerperal sepsis**. Thirty grains (2 Gm.) of the salt in 8 fluidounces (250 c.c.) of normal saline can be safely administered intravenously, but must be given slowly, at a temperature of 105° to 108°, twenty minutes being consumed in the process. A rapid flow into the vein is followed by embarrassed respiration. The drug was given as described 50 times, with frequent gratifying re-

sults. It may be given at intervals of twenty-four hours for several days.

In the cases of puerperal infection a gradual decline in temperature and pulse followed the use of the remedy. Blood-cultures from all cases save one showed pure streptococcus infections. Huggins (Jour. Ind. State Med. Assoc., Mar. 15, 1911).

External Uses.—Magnesium oxide and the carbonate are used as a toilet powder, to dry the skin, to prevent chapping and excoriation in **intertrigo**, and to relieve the irritation due to **sunburn** and that left after shaving. Magnesium carbonate is applied also as a cosmetic to relieve the shining appearance of the facial integument, cubes of the compound being generally preferred for this purpose.

Magnesium sulphate was shown in 1907 by H. Tucker to be of great value as an application in **local inflammatory conditions**. From 15 to 20 thicknesses of gauze, or a thin layer of absorbent cotton, should be placed as a covering over the entire inflamed area and kept continuously wet with a saturated solution of the salt, evaporation of which may be slowed by a final covering with oiled silk or waxed paper. The dressing is allowed to remain twelve to twenty-four hours, the parts being then washed with water and the dressing at once reapplied, if indicated. Pain is relieved and resolution of the inflammatory process hastened by this measure. A marked blanching of the affected surface is produced, but this is not followed by any deleterious effects. Tucker employed this procedure with marked success in cases of **gonorrheal epididymitis** and **orchitis**, **chancroidal bubo**, **gonorrheal arthritis**, **acute rheumatism**, **tuberculous peritonitis**, facial

erysipelas, **cellulitis**, alcoholic and traumatic **neuritis**, **sprained ankles**, and simple **contusions**. Among others, Filfield has also seen excellent results follow magnesium sulphate applications in **mastitis**, inflammatory conditions of the female genital organs, **boils**, and **carbuncles**. He prepares the solution by dissolving 2 pounds of magnesium sulphate in 1 gallon of hot water, and filtering when the solution has cooled. The applications of the solution should be continued until all signs of inflammation have disappeared, and, meanwhile, absolute rest for the inflamed part should have been procured. **Dermatitis** due to **poison ivy** is another condition in which application of magnesium sulphate solution has proven decidedly effective.

A man suffering from **thoracic aneurism** with projection of the chest wall had some slight cutaneous irritation over the mass. Application of magnesium sulphate solution was made. The relief to his deep pain was so great that he asked to have the dressing repeated. The effect was not lasting and the application had to be repeated from time to time. Other cases in which this apparently reflex analgesia was observed were cases of **gastric ulcer**, **gastric carcinoma**, **lymphatic leukemia**, **acute pericarditis**, **sciatica**, **headache** of unknown origin, and **chronic pleurisy**. The measure may be useful at times when one does not care to give morphine in cases of **deep-seated pains**, acute or chronic. S. Solis-Cohen (Jour. Amer. Med. Assoc., Dec. 4, 1909).

Magnesium sulphate used locally in 19 cases of **erysipelas** complicated with **alcoholism**, **acute nephritis**, **myocarditis**, and **pneumonia**, with only 3 deaths, and also in 35 uncomplicated cases, with no deaths. The application gives prompt relief

from local distress and causes a rapid and permanent fall of temperature, thereby eliminating possible febrile complications. The author only gives a milk diet for the first few days until temperature is normal. Choksy (Lancet, Feb. 4, 1911).

In **myalgia** and **lumbago** McCarty has had gratifying results by bathing the parts in a hot (110° F.) 1:16 solution of magnesium sulphate. The bath should last at least twenty minutes, the skin being meanwhile constantly wiped with a cloth, and the treatment should be repeated daily until the condition is cured. The same author recommends the use of compresses of a cold 1:16 solution in **tonsillitis** and even **pneumonia**.

Intramuscular injections of magnesium sulphate used in 5 cases of **articular rheumatism** with excellent results. The author uses a 25 per cent. solution, injecting in adults 4 c.c. into any convenient muscle. Jackson (N. Y. Med. Jour., June 24, 1911).

Waterhouse makes the following suggestions as regards the local use of magnesium sulphate: (1) In a troublesome condition of the ankles in old people in which the skin assumes a hard, crusty condition, with a dusky red or purplish color and frequent cracking, smarting, bleeding, and ulcer formation, the local use of magnesium sulphate solution softens the skin, enhances the blood-supply, and initiates granulation. (2) In **neuralgic conditions** application of magnesium sulphate solution along the course of the nerve involved will often relieve the pain in a few minutes. (3) In **malaria**, **typhoid fever**, and **measles** sponging the skin once or twice a day with magnesium sulphate solution is a useful measure. (4) Repeated applications of magnesium sul-

phate solution to **corneal scars** interfering with vision will usually remove the condition entirely in six months. (5) In parts of the country where **chigoes** and **fleas** are annoying, sponging with magnesium sulphate solution in the morning is an effectual preventive measure. (6) In **tooth-ache** plugging with cotton wet with magnesium sulphate solution is a useful procedure.

Magnesium sulphate used as a local dressing in **contused, lacerated, and incised wounds, inflamed and swollen joints, orchitis, infected wounds** with foul discharge, and in **moist gangrene** following injuries of the extremities. In all the conditions the results were uniformly good. B. B. Wheeler (W. Va. Med. Jour., Apr., 1911).

Mixture of saturated solution of magnesium sulphate and glycerin in equal proportions used for the cure of local infection in a series of 14 cases of **wounds** of various kinds, **infected blisters, felon, and cellulitis**. In the latter condition the arm was packed in the hot solution from fingers to shoulders. All the infections were quickly controlled. Freese (N. Y. Med. Jour., Feb. 14, 1914).

The writer found that **burns** of the **first and second degree** were invariably arrested in their development when molecular solutions of magnesium sulphate have been applied early. Third degree burns run, as a rule, a more favorable course under the application of magnesium sulphate than under any other treatment. Higher concentrations than 25 per cent. seem to exert a still better influence. The favorable action in advanced stages of burns of the second and third degree is less striking, because of the infection present, but even then it seems to exert a favorable influence and should be used in combination or alternately with antiseptics. Meltzer (Jour. Pharm. and Exp. Therap., xii, 211, 1918).

In **tetanus** intraspinal injections of a 25 per cent. sterile magnesium sulphate solution have been productive of good results in a number of instances. The dose originally recommended by Meltzer is 1 c.c. (16 minims) of this solution for every 25 pounds of body weight. Miller treated 11 cases with this solution, with 5 recoveries. The measure is not an absolutely safe one, as only a slight excess of magnesium solution is required to produce dangerous respiratory depression.

Case of obstinate **facial hemispasm** in which, after cocaine local anesthesia, 2 c.c. (32 minims) of a 50 per cent. solution of magnesium chloride were injected in the vicinity of the facial nerve, at its exit from the stylo-mastoid foramen. Slight numbness and swelling followed temporarily, but by the fifth day the clonic movements were much weaker, and on the tenth day they disappeared entirely and permanently. The same procedure might be applied to other nerves, including the spinal accessory in torticollis. Claude and Lévy (Bull. et mém. de la Soc. méd. des Hôp. de Paris, Mar. 7, 1913).

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MALARIAL FEVERS.—SYNONYMS.—Ague; intermittent and remittent fevers; chills and fever; quotidian, tertian, and quartan fevers; estivoautumnal fever; paludal fever; marsh fever; climatic fever; jungle fever; swamp fever; coast fever; mountain fever; hill fever; gnat fever; Roman fever; Chagres fever; Cameroon fever; chill fever; cold fever; hemamebiasis; paludism.

DEFINITION.—The term *malarial fevers* includes a group of closely allied infections characterized, as a rule, in

the acute forms, by periodic paroxysms having the three stages of chill, fever, and sweat. They are caused by the inoculation into the blood-stream, through the bite of a mosquito of the genus *Anopheles*, of certain specific protozoan parasites (*Haemaphys* [*plasmodium*] *malariae* and its related species) which attack and destroy red blood-cells. Chronic hemamebic infection manifests itself in various forms, and with its results is known as *chronic malaria* and *malarial cachexia*.

HISTORY.—The sober history of the development of our knowledge of the malarial fevers reads like a romantic fable wherein mighty giants of an hundred heads are met and conquered. Two of the giant-quellers (Laveran and Ross) have been awarded the Nobel prize in medicine, and a third (Gorgas) has been signally honored by the Congress of the United States as well as by American and foreign scientific associations.

Craig distinguishes four main epochs:

1. From the earliest records to the introduction of cinchona bark (1640).
2. From the introduction of cinchona bark to the discovery of the plasmodia (1882).
3. From the discovery of the plasmodia to the discovery of the method of transmission by the mosquito (1895).
4. From the discovery of the method of transmission until the present time.

The writers suggest that the fourth epoch should close with the achievements of Gorgas and his co-workers on the Isthmus of Panama, and would thus phrase its description: 4. From the discovery of *Anopheles* transmission to the banishment of malaria from the Panama Canal Zone and the completion of the canal. They would then add: 5. From the

completion of the Panama Canal (1914)—into the future. For perhaps we are on the brink of other epoch-marking discoveries in regard to the malarial fevers.

GEOGRAPHICAL DISTRIBUTION.—With the exception of the Arctic and Antarctic regions, malaria, although principally a tropical disease, exists over the entire surface of the habitable globe.

North America.—From Canada to the Isthmus it is found, though relatively less common and less malignant in the north than in the south, in the highlands than in the lowlands, and virtually absent from the altitudes. All forms are encountered in the Mexican coast regions, as in the Gulf States of the Union, and along the Mississippi and Ohio Rivers. It is prevalent through the Middle West, but less so in the Middle States, if one excepts certain regions of New Jersey, Delaware, and Maryland. The World War caused a marked recrudescence of malaria in Europe, especially in Italy.

Although indigenous malaria had not been noted in England over a century, several cases were brought there during the war. London letter (Jour. Amer. Med. Assoc., Oct. 20, 1917).

After the Spanish-American War practically everybody suffered from malaria in Cuba, with 4107 deaths in 1900. Thanks to American methods the mortality in 1913 was only 447 deaths. Le Roy (Rev. de Med. y de Cir., Aug. 25, 1919).

Central and South America.—Here it is a veritable menace. Some regions are uninhabitable, owing to the virulence of the infection. The Panama Canal Zone is an exception only because of the vigilance of the United States Army Medical and Sanitary Corps.

West Indies.—In the Caribbean Islands malaria is very prevalent, and especially the malignant forms. Cuba and Porto Rico are both severely infected.

Europe.—Great Britain and Norway enjoy only a comparative freedom. Benign tertian exists on the Continent. Greece, Sicily, Italy, and Turkey are the worst sufferers, and exhibit also many cases of estivo-autumnal, even pernicious infection. Quartan infection is not rare in the Mediterranean countries.

Asia.—India harbors the disease in all its forms and degrees of severity. The annual loss of life here is tremendous. Japan and the Philippines have no exemption. In Syria and Mesopotamia the morbidity is large.

Africa and Oceanica.—Parts of Africa are uninhabitable owing to the ravages of the disease. This is especially so along the Congo and Nile Rivers. In Egypt, Tunis, Tripoli, and Algeria the infection exists endemically. It is prevalent in Australia, along the coast, and the same is true of the South Sea islands in general.

ECONOMIC LOSS.—Howard has estimated the loss in the United States due to malaria, calculating the loss in wages, lowered production, care of the sick, and medical attention as \$100,000,000 annually. India's toll of death is given at the startling, almost incredible figure of 1,130,000 souls yearly. Celli states that "malaria annually costs the Italian Government incalculable treasure."

These bare, indisputable facts place the problem of control and eradication squarely up to all governments.

CLASSIFICATION.—Acute malarial fevers were formerly classified according to clinical type as *intermittent* and *remittent*,

the former being subdivided into *quotidians*, *tertians*, and *quartans*, with the rare forms showing fortnightly (14 or 15 days) recurrence of paroxysms, sometimes distinguished by special title, as *quatuordecimam*, etc. The fulminant, specially virulent cases were, and still are, termed *pernicious malaria*. The term *malignant malaria*, formerly used synonymously with pernicious malaria, is now applied by some writers to all forms of infection with crescent-forming parasites, whether of the specially pernicious types or not—i.e., synonymously with *estivoautumnal infection*. The syndrome marked chiefly by splenic tumor and profound anemia resulting from long-standing infection, was designated *malarial cachexia*—a term still in reluctant use. Cases of malarial infection (most frequently *chronic*) not revealed by frank paroxysms of chill and fever, but manifesting other symptoms, such as headache, myalgia, neuralgia, paralyses, gastric and other visceral crises, etc., were known as *masked malaria*, or *larval malaria*. In popular parlance, the terms *brow ache*, *dumb ache*, *sun pain*, etc., were employed, and the enlarged spleen of chronic malarial infection was called "ague-cake."

At present most students of malaria adopt one or the other of two classifications based upon the type of the infecting organism,—(a) Mannaberg's and (b) Craig's modification of Schaudinn's.

Mannaberg's classification follows: 1. Fevers produced by Golgi's common tertian and quartan parasites. 2. Fevers produced by crescent-forming parasites. 3. Fevers produced by an association of both forms. 4. Latent infections.

Craig's classification, which in the main has been adopted in this article is the following: 1. Tertian malaria (*Plasmodium vivax*). 2. Quartan malaria (*Plasmodium malaricæ*). 3. Tertian estivoautumnal malaria (*Plasmodium falciparum*). 4. Quotidian estivoautumnal malaria (*Plasmodium quotidianum*).

We shall, however, use the term *hemameba* in preference to *plasmodium*, and shall take account, with Mannaberg, of *mixed infections* and, with traditional as well as modern medicine, of *latent* or *masked* infections. *Chronic infection* and its resultant *malarial cachexia* are likewise considered.

ETIOLOGY.—Methods of Infection.—Three main theories of the mechanism of malarial infection may be mentioned: 1. Through the digestive tract—water theory. 2. Through the respiratory tract—air theory. 3. The inoculation theory.

Although the air and water theories still have a few adherents, the available evidence against them is so overwhelming that they may be dismissed from consideration. The present status of the question is well summarized by Bignami: "This much at any rate we can assert, namely, that inoculation is the only mechanism of infection which has been demonstrated experimentally."

Predisposing Factors.

These may be considered under two heads—environmental and individual.

A. Environmental.—1. *Climate.*—Malarial fevers are more prevalent and more virulent in hot and damp climates, especially tropical and subtropical countries in which there are extensive swamps and jungles—conditions which favor the propagation of mosquitoes and probably affect also the intensity of the life of the malarial parasites. The infections of the temperate zones are more commonly benign. Malarial fevers are found wherever conditions favor the life of the mosquito. In Philadelphia, "the Neck," a region of marshy truck farms, was long the habitat of the disease, while residents of the built-up districts suffered chiefly when the streets were torn up—and especially after spring and summer rains. In any climate infested by mosquitoes of the genus *Anopheles*, and in which infected human beings live, malaria will persist, and must be repressed by public and private precautions.

It has been found that the malarial parasite will not develop with a mean temperature below 60° F. As great altitudes are for the most part cool and dry, afford better drainage, and in consequence are poor breeding places for both parasite and insect, it is easily seen why marshy lowlands suffer most. Exceptions to this are found in the Philippines and in South America.

2. Rain and Moisture—Soil.—Rain and moisture furnish the best conditions for the development of breeding places, and the soil which favors the formation of stagnant pools is like a virulent focus for infection. These conditions are found in forests and swamp lands, and in soil which does not admit of free drainage.

3. Season.—The influence of season is shown in the following tables, compiled by Thayer, of Baltimore; the Isthmian Canal Commission, and Celli, as regards their respective countries and climates. It will be seen that the greatest number of cases occur in summer and early fall. The estivoautumnal types reach their height in the autumn in the tropics, and during late summer in temperate climates, while the simple tertian variety is most common during the summer.

B. Individual Causes.—1. *Race.*—It is said that dark-skinned races are less susceptible, partly by natural resistance and partly owing to an immunity gained by repeated infections during childhood. New arrivals in malarial districts are more susceptible than older inhabitants, especially if they belong to light-skinned races.

2. Sex and Age.—As a rule, men are the most exposed. When both sexes are equally exposed the ratio of infec-

TABLE 1.—CELLI'S TABLE: SEASONAL VARIATION IN ITALY.

Months	Years														Total
	1864	1865	1873	1874	1877	1878	1892	1893	1894	1895	1896	1897	1898		
January	284	195	853	459	638	661	240	189	249	236	314	129	90	4673	
February ..	228	198	681	528	519	543	177	125	163	175	243	94	58	3732	
March	189	170	711	747	544	502	231	119	125	165	244	98	61	3906	
April	168	151	653	675	564	576	223	148	157	180	235	115	76	3921	
May	112	114	669	584	480	504	244	119	159	165	229	120	76	2575	
June	83	88	409	331	339	375	205	119	138	150	155	88	73	2553	
July	439	340	1135	865	1858	398	608	553	813	582	502	320	431	8844	
August	1492	570	2824	2647	2373	1604	694	741	1298	1181	939	410	905	17678	
September ..	1056	476	2185	2019	1995	1896	586	761	984	1357	684	505	799	15203	
October	775	437	1761	1732	1460	1495	500	911	855	1191	532	403	703	12755	
November ..	431	475	1280	1186	795	1245	404	831	678	898	361	215	732	9531	
December ..	271	205	777	773	695	1193	311	427	427	767	252	137	386	6621	
Total	5528	3419	13938	12682	12260	10992	4423	5043	6046	6947	4690	2634	4390	92992	

TABLE 2.—THAYER'S TABLE: SEASONAL VARIATION IN BALTIMORE.

Type	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Tertian.....	12	12	28	51	76	68	131	161	153	168	54	17
Quartan.....	3	1	0	1	0	0	3	0	2	1	4	2
Estivoautumnal..	5	1	2	5	0	3	37	99	191	203	63	22
Combined.....	0	1	1	0	0	1	3	3	4	11	6	2
Total.....	20	15	31	57	76	72	174	263	350	383	127	43

TABLE 3.—ISTHMIAN CANAL COMMISSION, 1911.

Months	Discharged		Died		Total Cases	Annual Average per 1000 of deaths	Annual Average per 1000 of cases	Number of Employees
	W.	C.	W.	C.				
January.....	180	157	1	1	339	0.51	86	47,348
February.....	217	156	1	..	384	0.24	93	49,785
March.....	239	167	..	1	407	0.25	102	47,935
April.....	190	138	1	..	329	0.25	81	48,634
May.....	461	463	1	3	928	0.99	230	48,496
June.....	756	981	4	4	1745	1.98	432	48,519
July.....	747	1226	4	4	1981	2.01	497	47,801
August.....	396	506	3	2	907	1.21	219	49,710
September.....	322	339	3	..	664	0.76	168	47,400
October.....	253	249	1	..	503	0.24	121	49,812
November.....	199	210	4	1	414	1.19	99	50,420
December.....	191	193	1	1	386	0.47	91	50,655
Total.....	4151	4795	24	17	8987	0.84	184	48,876

tion is the same. Children are less resistant to infection than adults.

Malarial infection is less frequent in the infant than in the child or adult. Malaria, in the infant, is a serious disease, and demands prompt recognition and treatment. A positive diagnosis can not be made ex-

cept by repeated blood examination. Therapeutic diagnosis should not be made unless it is impossible to make a diagnosis by blood examination. The treatment of malaria in the infant is as in the adult. Morgan Smith (Trans. So. Med. Assoc.; N. Y. Med. Jour., Jan. 19, 1918).

The exhibition of substances causing the spleen to contract (adrenalin, ergot, hypophysis) can cause the malarial organisms contained in the splenic parenchyma to make their exit and enter the circulation. This blood infection, which allows one to detect latent malaria, is not accompanied by a typical thermic paroxysm. The organisms enter the blood from 4 to 6 hours after the injection, more quickly after adrenalin, but more lastingly after pituitary. Neuschlotz (Münch. med. Woch., Jan. 22, 1918).

3. *Occupation*.—Laborers upon the soil, ditch diggers, railroad builders, etc., especially where through great enterprises the soil is turned and returned, favoring the formation of stagnant pools, are especially liable—the more so in highly malarious districts—to infection. Morbidity is increased where night work is required. In a less degree, but according to the extent of their exposure, engineers, contractors, supervisors, and other officials engaged in railroad and canal construction, etc., are similarly liable. Soldiers in camp or “on the hike” in malarial countries and climates suffer largely.

4. *Social and Hygienic Conditions*.—Poorly nourished individuals, dwellers in insanitary abodes, and those who are careless of their personal hygiene or of prophylaxis—as in sleeping near the ground without protection—often succumb to the infection. Especially is this true of the laboring and peasant classes and of soldiers.

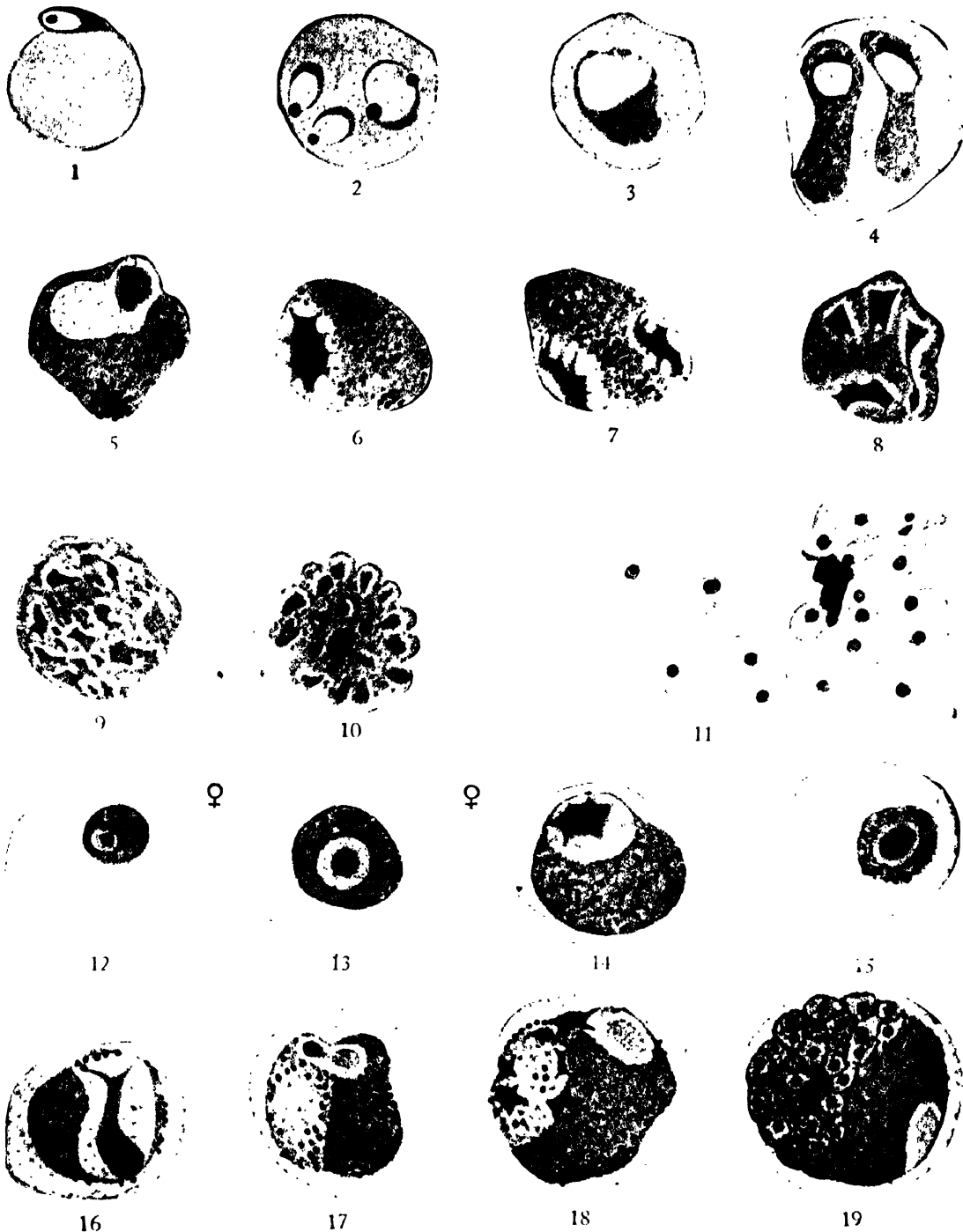
Parasitology.—The parasites of malaria (malarial organisms, malarial corpuscles, plasmodia, hemamebæ), discovered by Laveran in 1882, have two cycles of development—one within certain mosquitoes of the genus *Anopheles*; one within man.

The *mosquito cycle* is sexual (*sporogony*); the *human cycle*, for the most part, asexual (*schizogony*). Whether or not the parasites have, in the present stage of evolution, a third, non-parasitic stage of existence is mooted, but there is no evidence of such. Bass has succeeded in cultivating them *in vitro*, but only within the red blood-cells of man. Apparently they are transferred from insect host to human host, and back again to new insects, new men, continuously. Hence malarial fevers, while dangerously transmissible, are not contagious; i.e., they are not directly infectious from patient to patient.

In man the parasites chiefly inhabit the blood-stream, living on and within the red corpuscles, by destroying which they produce anemia and the peculiar pigmentation of malaria. They can sometimes be demonstrated during life in blood taken from the spleen, when examination of the peripheral blood fails to reveal them. *Post mortem* they have been found within the blood-vessels of all the organs and tissues.

Several species, types, and varieties of malarial organisms are recognized and have received distinctive names. Of these, sharp distinction may be made between two groups, the *crescent-forming* and *non-crescent-forming* hemamebæ. The former, highly resistant and dangerous, give rise to the so-called *malignant* or *estivoautumnal* infections, while the latter cause the comparatively mild and manageable *ordinary* infections.

The non-crescent-forming organisms are commonly spoken of as (ordinary) *tertian* and *quartan* parasites, from the periodicity (about forty-eight hours and about seventy-two hours, respect-



TERTIAN MALARIAL PARASITE (*Plasmodium vivax*). (Billet: *Traité du Sang* of Gilbert and Weinberg.)

1 to 11, asexual forms. 1, normal red cell with merozoite about to enter; 2 and 3, early ring forms; 4, pigmented hemogregarinoid form; 5, adult schizont; 6 to 10, segmentation; 11, liberation of merozoites. 12 to 14, sexual forms. 12 to 14, development of macrogamete or female gamete; 15 and 16, development of microgametocyte or male cell; 17 to 19, parthenogenesis in a macrogamete.

ively) of the paroxysms that they excite. The crescent-forming organisms are commonly spoken of as *estivo-autumnal* parasites, from the season of the year (summer and autumn—i.e., the *hot months*) in which the fevers they originate are most frequently met with. They are of two varieties, *quotidian* and *tertian*, showing a periodicity, respectively, of about twenty-four hours and about forty-eight hours.

Non-crescent-forming Organisms.—The *tertian* parasites, *Haemaphys* (or *Plasmodium*) *vivax*, in their **human cycle** (*schizogony*), appear first within the red blood-cells, as small, actively ameboid, hyaline bodies—the *schizonts*. These are of various shapes, their outlines changing with their ameboid movements. In this *hyaline stage* the organism is ill defined, and can be discerned only by very careful examination. A few minute, reddish-brown granules appear within it—pigment elaborated by the organism from the hemoglobin of the invaded red cell. The pigment granules show a constant and rapid movement, which is, however, passive, not active, and is the result of protoplasmic flow within the parasite. At first the schizont occupies but a small portion of the infected cell, but in its progress to maturity it gradually encroaches more and more upon the substance of the latter, until at the end of about thirty-six hours there is left but a narrow and much dilated rim of cell substance inclosing the almost full grown organism. This has a well-defined circular outline. Ameboid motion has become almost entirely lost, but the pigment, which is much increased in quantity, is still granular and more or less motile. The diameter of the ring of eryth-

rocyte substance inclosing the *adult parasite* is much increased—nearly double that of the normal corpuscle. Toward the end of from forty-five to forty-eight hours, *segmentation* of the parasite takes place. The pigment begins to clump in the center or at one side of the organism, and the *rosette stage* is formed. Fine radial divisions branch out from the center toward the periphery, dividing the parasite into small ovoid sections (or segments) known as *merozoites*. These vary in number from 12 to 24, the average being about 16. Generally they are arranged in two rows, one row about the center of the organism and the other peripherally to this; but irregular arrangement is not rare. The merozoites are always free from pigment. The rosettes now undergo complete division, each merozoite becoming a separate living entity.

The infected red cell has by this time apparently disappeared. Its destruction by absorption or rupture liberates the rosettes or the separated merozoites, which last, infecting new erythrocytes, again appear as schizonts. The life-cycle within man thus continues.

The process of segmentation and division is termed *sporulation*, and its acme coincides with the clinical paroxysm. It is at this stage that parasiticides, especially quinine, are most effective. Indeed, it has been shown that the blood-serum alone destroys many of the merozoites, and others, even the undivided rosettes, are engulfed by the phagocytes. Phagocytosis of red cells containing dead parasites also takes place. According to Bass, but 1 segment in 15 or 30 survives to infect new red

corpuscles. This observer indeed, basing his opinion upon his ingenious culture experiments, asserts that the young parasites cannot exist free in the blood. He believes that they must pass directly from infected to uninfected cells, where the erythrocytes are crowded together in the capillaries, and this only when the opening for the exit of merozoites from the red cell is toward another in contact with it. If the opening in the infected cell occurs on the side in the direction of the blood-current, the merozoites are killed at once.

A certain proportion of the adult parasites, however, do not segment, but become flagellated. These are the *gametes* or sexual forms, which are destined to carry on the life cycle of the organism in the mosquito—*sporogony*. They have been observed chiefly in blood which has been for some time (eight or ten minutes) removed from the body, and were thus first demonstrated; but it is now known, as predicted by the senior writer, that a certain number of sexual parasites are formed within the human vessels, probably in the deeper and less active portions of the circulation, and it is possibly thus that chronic and larval infections are maintained.

The flagellated organisms are of two kinds, designated by Craig as *active* and *passive*. The active flagellated organism, also termed the *microgametocyte*, is at first a spherical body filled with motile pigment, distributed throughout the protoplasm in the form of small granules. The motion of these granules becomes more and more rapid, indicative of greater and greater activity of the protoplasm, until finally, at the cir-

cumference of the organism, 3 or more thread-like and wavy prolongations (flagella) are put forth, which may be in length from 3 to 4 times the diameter of the parasite. They exhibit active lashing movements, and when separated from the main body of the parasitic cell are known as *microgametes*. Roughly, they correspond to the spermatozoa of higher animal forms.

The passive flagellated organism, or *macrogamete*, is a round body containing pigment in larger, immotile clumps, generally arranged in ring form around the periphery. These bodies do not of themselves produce flagella, but upon the slide, in drawn blood, flagella from the microgametocytes which have become free in the plasma can sometimes be seen attached to the macrogametes.

In nature it is in the stomach or middle intestine of the **mosquito** that the conjunction of male and female elements—of micro- and macrogamete—takes place. The fertilized female cell is known as the *sporont*. It becomes elongated and finally motile, and is then known as the *ookinete*. The ookinete penetrates the wall of the middle intestine and attaches itself to the basement membrane of the intestine, on the lower side of the epithelium, between the adipose tissue and the muscular wall. Here it becomes spherical in shape, forming the *oöcyst*, about the third or fourth day after the mosquito has bitten an infected individual. The protoplasm of this cyst is granular and reticular in appearance; the pigment is reduced in amount, and the whole is inclosed within a well-defined capsule. About the fifth or sixth day the oöcyst enlarges and



QUARANTY MALARIA PARASITE (*Plasmodium malariae*). (Billet. *Traité du Sang* of Gilbert and Wenberg.)

1 to 17. Asexual forms. 1, red cell containing ring form; 2, racket form; 3, bacilloid form; 4, pyriform form; 5 to 8, pigmented hemogregarinoid forms; 9, band form; 10, adult schizont; 11 to 17, segmentation. 18, macrogamete; 19, microgametocyte; 20, parthenogenesis in a macrogamete.

within it are formed spherical, refractive bodies known as *sporoblasts*, which in the course of a week or so develop into a large number of delicate filaments having pointed extremities and containing a small amount of nuclear chromatin. These are the *sporozoites*. Liberated by the rupture of the cyst, the sporozoites make their way to the tubules of the salivary glands of their insect host, and thus the infected mosquito, when biting a man, inoculates them into the blood-stream. Penetrating the red blood-cells, they appear as hyaline bodies, that develop, as did the schizonts, into merozoites, and so, again, the human cycle of the organism goes on. The entire cycle of development in the mosquito is about fourteen days.

Like the tertian parasite, the organism causing **quartan** malarial infection (*Haemaphys* [or *Plasmodium*] *malariae*) appears at first within the **human** red blood-cell as a small hyaline body without pigment—the *schizont*. Its ameboid motion is less marked than that of the tertian organism. It rapidly becomes pigmented, the granules being larger than those of the tertian parasite, darker, less motile, and arranged around the circumference of the organism. During all stages of its growth, the quartan parasite is more distinct in outline than is the tertian. The infected erythrocyte in quartan fever does not become pale and distended, but is normal or even slightly less than normal in size, and green in color. This difference serves at once to distinguish the two varieties of infection upon microscopic examination. The parasite slowly enlarges, becoming at the same time less ameboid. The pigment increases in quantity

and, collecting at the extreme periphery of the organism, becomes absolutely immotile.

The parasite tends more and more to fill the infected erythrocyte, and when it is full grown there is visible but a small greenish rim of hemoglobin around the periphery. The plasmodium is now distinctly outlined, being much more refractive than is the tertian organism. At the end of about seventy-two hours, segmentation occurs, the pigment collecting at the center in a star-like arrangement. Radial striations appear, dividing the organism into from 8 to 12 merozoites, which, as a rule, are arranged in a perfectly symmetrical manner around the central pigment, giving rise to the so-called "daisy" or "marguerite" form of the rosette.

The infected red cell ruptures or dissolves; complete division of the rosette occurs; the separated merozoites become free in the blood-plasma and, in the human life-cycle, again invade the red corpuscles, to repeat the changes which have been described. As in the case of the tertian parasite, certain of the adult organisms do not undergo segmentation. These, forming within the **mosquito** micro- and macro- gametes, carry on the sporogony, which is much the same as that of the tertian organism.

Crescent-forming Organisms.—Marchiafava and Bignami, confirmed by Craig, have described two distinct varieties of the estivoautumnal parasite—the *quotidian* and the *tertian*.

The **quotidian** parasite—*Haemaphys* (or *Plasmodium*) *falciparum* *quotidianum*—is rare in this country. In its **human cycle**, or *schizogony*, it appears at first in the infected red cell

as a minute *hyaline body* of indistinct outline and difficult to detect—the round or ring-shaped *schizont*. Close inspection reveals active ameboid motion. As it matures, the organism gradually becomes better defined, and when full grown is clear cut and refractive. The *round type* is hyaline in appearance throughout, but the more common *ring form* consists of a narrow hyaline margin enclosing a small area of greenish-yellow hue. This has been thought to indicate that the center of the parasite is much thinner than the periphery, thus allowing the normal color of the corpuscle to show through. Careful observation, however, has demonstrated that the ring forms often become uniformly hyaline, and that in so doing the protoplasm of the organism flows in from the edge of the ring. It is much more probable, therefore, that no protoplasm existed in the greenish area. The infected red corpuscles are generally smaller than the normal corpuscles and dark green in color. They are often crenated. Not rarely, double or triple infections of the corpuscle may be observed. Pigmented forms are less numerous than the hyaline bodies, but not uncommon. As a rule, the pigment appears as a small, solid block, very dark, almost black in color, sometimes at the edge of the parasite, sometimes at the center. It is never motile. Very rarely it consists of fine granules, but never more than 3 or 4. *Segmenting forms* of the parasite are seldom observed in the peripheral blood, although readily demonstrated in blood taken from the spleen at the proper time in well-marked cases. Just before segmentation the parasite occupies about one-

fourth of the infected blood-cell, thus distinguishing it from the quartan and tertian parasites which fill the corpuscle. At the end of about twenty-four hours, the pigment becomes collected at the center of the organism and radial striations can be detected, starting from the center and dividing the parasite into from 6 to 8 very minute round or oval *microzoites*.

Complete division occurs within the infected red cell. The merozoites are then liberated by its rupture. Each merozoite is capable of again infecting a red cell, and the human cycle is thus repeated.

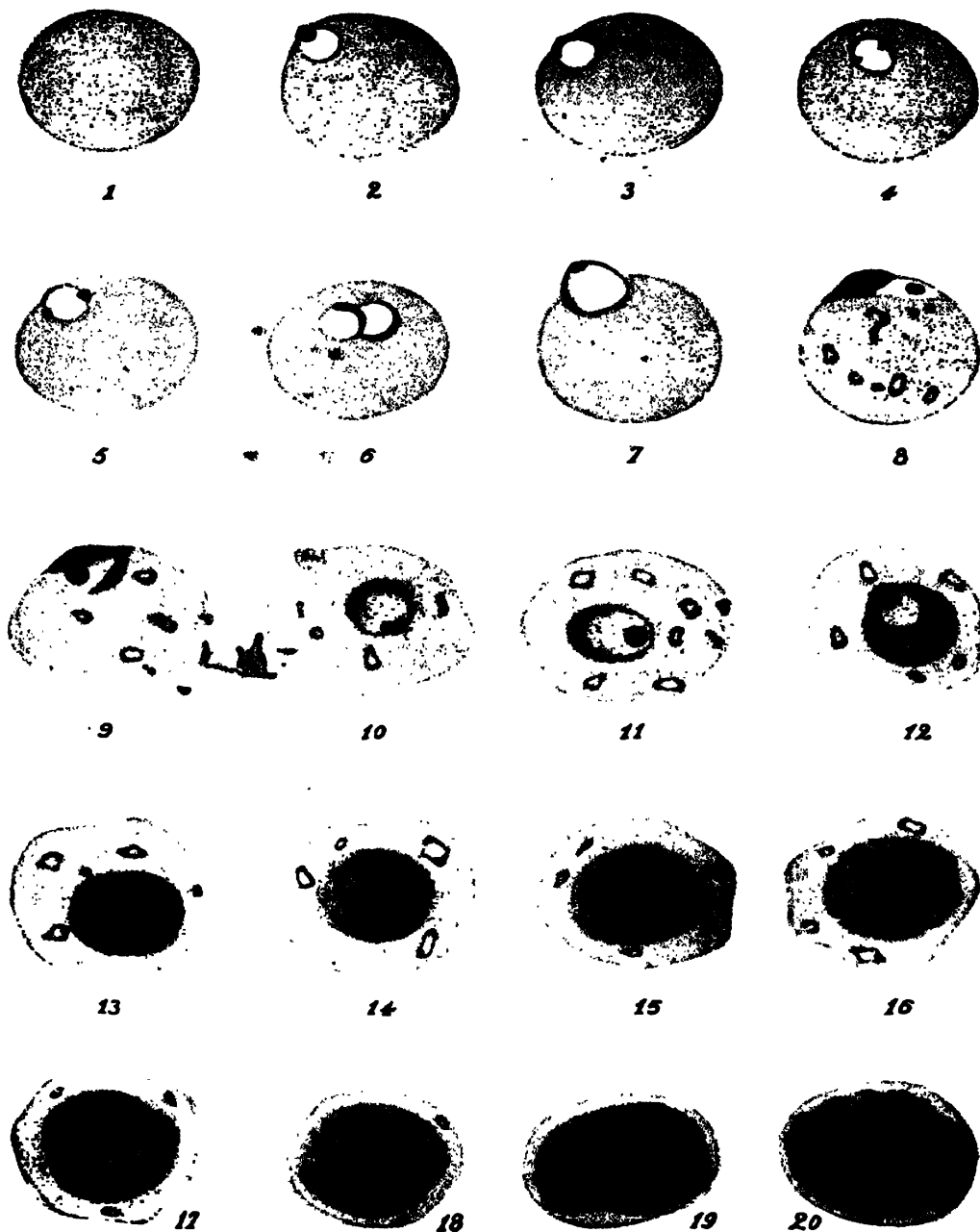
Both in the quotidian and in the tertian estivoautumnal parasite there are developed within the red blood-corpuscle certain bodies which do not undergo segmentation. These are the so-called *crescents*, which are destined to carry on the sexual cycle (*sporogony*) of the estivoautumnal organism within the *mosquito*. They are highly refractive, exhibit a more or less granular protoplasm, and contain pigment which is arranged in the form of slender rods or minute dots. In the younger crescents this pigment is distributed throughout the protoplasm, but as the organism matures it collects at the center or at one pole. The border of the crescent is sharply cut and is represented by a single or double line, having a peculiar greenish color. When the crescent is full grown, careful examination will most frequently show a somewhat convex and peculiarly pale green line upon the concave border of the parasite. This represents the remnant of the red blood-cell in which the parasite developed.

In quotidian estivoautumnal infection the crescent is generally much



ESTIVOAUTUMNAL MALARIAL PARASITE (*Plasmodium falciparum* Sexual forms: Female gametes or macrogametes; male gametes or microgametocytes, Parthenogenesis). (*Billet*—*Traité du Sang* of Gilbert and Weinberg.)

1 to 7, intracorpuseular cycle of the gametes. 1, young female gamete; 2, young male gamete; 3 and 4, older female gametes; 5, adult female gamete (crescent); 6, adult male gamete (crescent); 7, two macrogametes in a single red cell. 8 to 12, extracorpuseular cycle of the gametes. 8 to 12, Loss of the cell capsule; 13, motile, anchoid macrogametes; 14, non motile microgametocyte; 15, extrusion of flagella or microgametes by microgametocyte; 16, flagella; 17 to 20, parthenogenesis in a macrogamete.



ESTIVO-AUTUMNAL MALARIAL PARASITE (*Plasmodium falciparum*. Asexual Forms). (*Billet: Traité du Sang* of Gilbert and Weinberg.)

1, normal red cell; 2 to 6, ring forms; 7 to 10, entrance of parasite more deeply into the red cell; 10 to 20, intracorporeal forms; 13, adult schizont; 14 to 20, segmenting forms (schizogony).

shorter and plumper than in the tertian. Its extremities are rounded, and it always presents a distinct double outline. The protoplasm is less granular and the pigment is smaller in amount, and in the form of dots.

In the mosquito (and upon the slide in the blood which has been drawn for some time) the crescents undergo a series of changes, first becoming oval and then round. These spherical bodies correspond to the *microgametocytes* and *macrogametes* of the tertian and quartan infections, and in the mosquito undergo similar changes. The microgametocytes become flagellated; the male elements (flagella, or microgametes) become free and fertilize the female elements (*macrogametes*); the *sporont*, the *ookinete*, the *oöcyte*, the *sporoblasts*, and finally the *sperozoites* develop, and the latter, entering the proboscis of the mosquito, are again inoculated into human beings.

Like the quotidian, the tertian estivoautumnal parasite—*Hamamæba* (or *Plasmodium*) *falciparum* (*tertianum*)—in its schizogony, or human cycle, appears first within the infected red cell as a hyaline ring or disk. The infected corpuscle is greenish in color, smaller than the normal corpuscles, and generally crenated. The young parasites are considerably larger than the corresponding forms of the quotidian organism, occupying from one-fourth to one-third of the area of the infected red cell. The ring forms are irregular in outline, one portion being larger than the rest, giving the so-called "signet-ring" appearance. The organism is highly refractive, and sharply defined, as with a punch. Rarely is more than a single parasite seen within the cor-

puscle. Ameboid motion is less rapid than in the quotidian form, and as growth increases it becomes lost. The ring shape alters to the rounded form, and when full grown the organism occupies about one-half of the infected red cell. In the course of from twenty to twenty-four hours the hyaline forms exhibit fine, reddish-brown granules resembling those found in the quartan parasite. The pigment is generally motile. Segmentation occurs in from forty-five to forty-eight hours. The pigment collects at the center and radial striations starting from this point divide the parasite ordinarily into from 10 to 15 merozoites, although as many as 24 segments have been counted in some instances. Division of the rosette occurs within the red cells. The segmenting forms, however, are seldom found in the peripheral blood, although frequently very numerous in blood collected from the spleen. The merozoite segments liberated in the blood-plasma again infect the red cells, and thus the cycle is repeated.

The crescent of the tertian estivoautumnal infections is much more slender than that of the quotidian form, and has pointed extremities. It seldom shows a double outline. The protoplasm is finely granular and the pigment is large in amount and in the form of slender rods. The sporogony (*mosquito cycle*) is like that of the quotidian organism.

Crescents are produced from the ordinary asexual spores of *P. falciparum* owing to a development of immunity toward the latter. They develop somewhere in the internal organs and then appear suddenly in the peripheral blood. The period required for their development is about ten days. Crescents do not generally

live more than a few days in the peripheral blood. They may be present in the peripheral blood during periods as long as eight weeks. Fresh broods of crescents appear in the blood daily. Thomson (Annals of Trop. Med. and Parasitol., Apr., 1911).

The writer has obtained positive cultures of plasmodia from 29 cases of estivoautumnal malaria, 6 of tertian, and 1 of quartan. He has carried the cultures on as far as 4 generations. He has only observed the asexual cycle of the parasite. The plasmodium develops readily in the red blood-corpuscle, and apparently digests the substance of the corpuscle. Segmentation can be followed satisfactorily in the cultures. Bass (Jour. Amer. Med. Assoc., Sept. 21, 1912).

Tree breeders should be taken into consideration. Even with present limited knowledge of their powers of transmission they constitute a factor which must not be ignored, whether in making anopheline surveys or in dealing with anophelines from the sanitarian's standpoint. Blacklock. (Lancet, Mar. 5, 1921).

Intracorpuseular Conjugation.—It is difficult to account for some of the cases of long-continued, latent, masked, and recurrent infections—especially those of semiannual and annual recurrence over long periods of years as described by the senior writer without reinfection. We are inclined to believe with Celli that there is a highly resistant resting or larval form of the parasite, which takes refuge in the deeper tissues, spleen, or bone-marrow, and under certain conditions reproduces and again invades the peripheral bloodstream. We are of opinion from our clinical studies that the irritation of a relatively small dose of quinine may be one of these conditions. Archibald Billings early in the nineteenth century observed masked malaria pass into frank ague when the patient was re-

moved from the sea level to altitude, or from an ague-stricken to a free locality, or when a relatively small dose of cinchona was given. Craig has observed a phenomenon which he thinks throws light on the subject—the conjugation of two young hyaline ring forms within the red cell, and before the formation of pigment. He believes that this is absolutely necessary to the continuance of malarial infection in man, and that in cases in which it does not occur the organisms undergo asexual sporulation for a time and then perish—this leading to spontaneous recovery. He has observed conjugation most frequently in cases presenting severe symptoms. It occurs with all varieties of organisms, though most readily demonstrated in estivoautumnal infection. It has three stages, termed by Craig (1) protoplasmic union; (2) complete protoplasmic amalgamation; (3) chromatic union. The spherical pigmented organism thus formed is liberated, and Craig believes that it may become encysted and thus enter upon a resting or *zygote* stage. Young organisms—spores—develop within it, and when released (after some long or short period) enter the red corpuscles, initiating a new schizogony.

Malarial Mosquitoes.—Only one genus, so far as is known, is capable of propagating malaria—the *Anopheles*. Of the 50 or more known species belonging to this genus, the following, according to Craig, have been shown experimentally to transmit the disease:

In Africa—*A. costalis*; *A. paludis*; *A. funesta*.

In India—*A. rossii*; *A. culicifacies*; *A. theobaldi*; *A. barbirostris*.

In Europe—*A. superpictus*; *A. maculipennis*; *A. bifurcatus*.

America—*A. maculipennis* or *punctipennis*; *A. argyrotarsis*; *A. crucians*.

Immunity.—The pigmented races appear to enjoy a relative immunity to malaria, which increases with the density of the pigment and is greatest (a) in the natives of malarial regions, and (b) in the most vigorous individuals. American negroes from non-malarious districts may become infected upon change of residence, although apparently less liable to infection than Caucasians, and although the negroes of the Gulf States and the West Indies do exhibit a high degree of immunity. It is probable, therefore, that a certain resistance is acquired as a result of repeated infections in childhood. The greatest prevalence of this immunity is found in East Africa; it is less in West Africa, and still less among the brown races in the Philippines. On the other hand, it is not observed among Italians in Italy or elsewhere. Kelch and Kiener, indeed, deny that any Europeans gain immunity, either by repeated infections or by acclimatization. They admit, however, a "relative tolerance" or a "diminished reaction." To this Manna-berg agrees, but also states that immunization does occur among East Africans, East Indians, Arabs, and Chinese.

SYMPTOMS AND CLINICAL COURSE.—Period of Incubation.

No fixed period of incubation has been determined. It varies between six and fourteen days, depending upon the type, virulence, and number of the infecting parasites. Mannaberg's inoculation experiments gave these results:—

Tertian: 7 cases, minimum six days, maximum twenty-one days, mean eleven days.

Quartan: 5 cases, minimum eleven

days, maximum eighteen days, mean thirteen days.

Estivoautumnal: 7 cases with hema-mebæ without crescents, minimum three days, maximum fourteen days, mean six and five-tenths days; 2 cases with crescents, thirteen and fifteen days.

These experiments accord with what is known clinically, viz., that the milder the infection, the longer the incubation period. They may be compared with the senior writer's demonstration of the *freedom periods* following the subcutaneous injection of a single dose of 15 grains (1 Gm.) of quinine and urea hydrochloride. These were found to divide into two groups, irrespective of organisms, averaging in double tertians and tertians six and one-half and thirteen days, respectively. In one quartan case it was twelve and three-eighth days. It was observed, however, that organisms were present in diminishing number for three days after the injection, and reappeared and began to multiply about three days before the postponed paroxysm.

Symptomatology.

Simple Tertian Malarial Fever (*Hamamaba vivax*).—This is the most common and mildest form of infection met with in temperate climates. The paroxysms occur every forty-five to forty-eight hours, with the sporulation of a single group of parasites, each member being in approximately the same stage of development. Daily paroxysms (*double tertian*) indicate a double infection, with two groups of parasites. The interval between daily paroxysms is rarely an exact period of twenty-four hours. In many instances observed by the senior writer it was alternately twenty-one hours and twenty-four hours—thus indicating

forty-five hours as the time of ripening of each group. Sometimes it is (approximately) twenty-three hours, the paroxysms, as it is said, "advancing an hour" each day—again indicating a period of forty-five or forty-six, rather than forty-eight, hours.

The *paroxysm*, when typical, is divided into chill, fever, and sweating stages.

The *chill* is usually preceded by certain *prodromes*—headache, nausea, aching of the back and extremities, and a general sense of malaise or discomfort. As a rule, the onset is gradual. Chilly sensations are experienced in the feet (sometimes in the upper extremities) and spread upward along the thighs and spine, until, with the fully developed rigor, the teeth chatter and the body shakes violently. The face and lips become cyanotic, the skin of the trunk and extremities presenting the "goose-flesh" appearance (*pilomotor reflex*). Nausea increases, and vertigo and dimness of vision may develop; sometimes there is vomiting. The pulse is hard, rapid, and irregular. Although the patient complains of intense cold, asking for more bedcovers, and the surface of the body is cool, the thermometer shows an elevation of internal temperature, which (taken in the rectum) may reach 105° or 106° F. Large quantities of pale urine of low specific gravity may be passed during the chill, but, as a rule, this is a later phenomenon. The cold stage ordinarily lasts from ten or fifteen to thirty minutes, but may continue for an hour or longer in severe cases.

Gradually superseding the chill comes the *febrile stage*. The body temperature, which continues to rise, begins to impress itself upon the subjectivity. Warm flushes succeed the cold sensa-

tions, until the latter are lost and the patient throws off his bedclothing, complaining of the intense heat.

The skin becomes hot, dry, and reddened. The conjunctivæ are injected. The pulse becomes rapid, full, and bounding and the respiration hurried. Throbbing headache, tinnitus aurium, and delirium are sometimes present in severe cases, or the patient may become drowsy and sink into a semicomatose or comatose condition. Constipation is the rule, diarrhea occasional. Herpetic eruptions, erythema, and urticaria are not uncommon at the height of the febrile stage. Epistaxis is less frequent. In some cases petechiæ and even purpuric spots are seen. Enlargement of the spleen may ordinarily be detected. The duration varies from four to six hours.

As the fever declines, *sweating* begins. Great relief is often expressed by the patient, from the coincident amelioration of the distressing symptoms. Commencing over the face, the moisture rapidly spreads until the entire body is bathed in a profuse perspiration. The temperature rapidly declines, becoming subnormal within two or three hours. Weakness of the circulation may now be manifested. The pulse and respiration lessen in frequency, and the patient falls into a refreshing slumber.

In children under 4 or 5 years the chill may be absent or pass unnoticed; but there is vomiting, sometimes profuse and persistent. The child is pale, sleepy, and prostrated, with lips and finger-tips blue, and the face is often anxious and drawn. Rapid rise of temperature to 104° or 105° F. (40° to 40.5° C.) follows, fever lasting three or four to ten or twelve hours. The subsequent sweating is not nearly so marked as in adults; it is sometimes apparently absent alto-

gether. The intervals between paroxysms are not always regular. Enlargement of spleen is usually present if the case has progressed without treatment. In irregular types of malaria in children, the most distinctive signs, outside of positive blood examination, are the periodicity of the temperature and the fact that the child seldom seems as ill as would be expected from the high temperature. Wherry (Archives of Pediat., Apr., 1911).

In examining for malaria, 147 children in the hospital at Grosseto during a period of three years the writer found that 90.9 per cent. of the children under the third year had malarial parasites in the blood, and 92.03 per cent. of those about 7 years old, while 74 per cent. of all the children had positive blood findings, the type of parasite not differing from those found in adults. It was surprising to find the parasite in many children apparently free from the slightest symptom of malaria and without any history of such. The malarial attacks in many of the infants came on without a chill or any vasomotor phenomena. In 10 out of 16 less than a year old the onset of the fever was associated with vomiting or convulsions, but these were never observed in children over 7, their attacks resembling those of adults, with the inevitable chill. V. Fusco (Policlinico, Feb. 18, 1912).

During the *intermission* which now occurs, the patient may feel perfectly well, but if treatment has not been instituted the paroxysm recurs at the appointed time (coinciding with the sporulation of the new brood of parasites) and follows the same course as before.

Double Tertian Infections.—Within the blood will be found two different groups of organisms reaching maturity on alternate days, thus giving rise to daily paroxysms. The relative intensity of the respective paroxysms will

depend upon the relative number in, and virulence of, the infecting groups. Sometimes one group is so much less numerous or less active than the other that the paroxysms remain tertian for some time, becoming of daily occurrence only when the second group of parasites has multiplied sufficiently.

Multiple tertian infection gives rise to a *remittent* or *subcontinuous* type of fever. As the various groups of organisms mature at different times, there is neither an evident periodicity nor a complete intermission during which temperature remains normal and the patient feels well; nor, after the first (or first few) paroxysms, is there likely to be distinctive repetition of the three stages of chill, fever, and sweat. "Remittent fever" is not so frequently described at the present time as a generation ago, nor is it so commonly met with in Philadelphia (we cannot speak for other localities).

Doubtless some of the cases that have been called "remittent malaria" were really typhoid fever—but not all of them. This form of fever is much more common and important in estivo-autumnal infections than in non-crescentic types.

Quartan Malarial Fever (*Hamæba malaræ*).—This is the rarest type of malarial infection. Craig observed only 26 instances in 5000 cases. The only undoubted cases (4 in number) seen by the writers (in Philadelphia) were in the persons of Italians, or of sailors from West Indian or South American ports.

In uncomplicated quartan infections, the paroxysms recur in about seventy-two hours, being coincident with the recurrent sporulations of a single group of parasites of approximately the same stage of development. The *symptoms*

are like those of tertian infections, but, as a rule, more severe. The combined duration of the chill, fever, and sweat is about twelve hours.

Cases of double infection have one free day between two paroxysm days in each seventy-two hours. In triple infection there is a daily paroxysm. Examination of the blood will reveal the different groups of infecting organisms.

Estivoautumnal Fevers (*Hæmaphysalis falciparum* [quotidianum]; *Hamamæba falciparum* [tertianum]).—According to Marchiafava and Bignami, confirmed by Craig, these fevers are caused by two distinct (crescent-forming) organisms, one of which completes its cycle of development in twenty-four hours (quotidian), the other in forty-eight hours (tertian). Either may give rise to fulminant symptoms, but about 75 per cent. of the cases of pernicious malaria are caused by the tertian variety. A remittent course, and various forms of irregular temperature curves are exceedingly common.

The estivoautumnal parasites may not be found, or may be found in small numbers only, in the peripheral circulation, but splenic puncture or post-mortem examination of the deeper tissues will reveal them—perhaps in considerable multitude.

We shall first consider the uncomplicated fevers, leaving the pernicious types for later discussion.

Tertian Estivoautumnal Fever; Malignant Malarial Fever (*Hæmaphysalis falciparum* [tertianum]); **Prodromal (Non-pernicious) Types**.—As in the ordinary tertian infection, the paroxysm recurs every forty-five to forty-eight hours with the sporulation of the successive broods of the parasite.

Cold Stage.—Distinct chill may not occur. In the majority of cases, chilly sensations creep along the spine, thighs, and buttocks. There is frequently an intense headache with profound weakness, muscular aching, and mental depression. The tongue is coated. The skin presents the usual goose-flesh appearance. The pulse is accelerated, feeble, and of poor volume; the respiration, rapid. The temperature may reach 103° F. or higher. The chilly stage, less intense than the ordinary tertian chill, lasts little longer than half an hour.

Hot Stage.—Sensations of warmth and flushing supervene upon the gradually fading cold stage, until the patient complains of the heat. The skin is red, dry, and hot; the eyes, injected. Severe pain may develop in the back, limbs, or abdomen. Nausea, vomiting, and diarrhœa are not uncommon; the urine is increased in amount. The pulse is rapid and jerky; the respiration is accelerated. This stage may last some sixteen or twenty hours. The temperature in a typical instance at first continues, perhaps with slight fluctuations, to rise and then maintains its height; a slight remission occurs, followed by a rapid fall, not, however, to normal (pseudocrisis), and a renewed (pre-critical) rise which is, at times, preceded or accompanied by chill. This may last for some time. Then comes the true crisis, accompanied with perspiration, more or less profuse. The duration of the febrile stage may be from twenty to twenty-four or even thirty-six hours.

Sweating Stage.—With the first fall in temperature and slight sweating, the symptoms decline, and with the crisis, as a rule, they disappear. The

period of normal or subnormal temperature (intermission) may last but a few hours, when another paroxysm ensues. The temperature curve in uncomplicated cases is absolutely diagnostic: 1. Initial rise. 2. Slight remission. 3. Pseudocrisis. 4. Pre-critical rise. 5. True crisis.

In **double** infections, there may be daily paroxysms of true type; or remittance, rather than intermittence be manifested. In **multiple** infections there may be a subcontinued or highly irregular form of fever. These forms greatly resemble typhoid fever, and have been miscalled *typhomalaria*. When they take on a grave type, with stupor and delirium, jaundice, intractable vomiting, profuse diarrhea, enlarged spleen, macular eruptions, dry coated tongue, sordes, and gingival hemorrhages, the resemblance to certain cases of typhoid may be still more marked. No discrimination is more important, since to mistake typhoid fever for malaria, is equally as harmful as an error in the opposite direction.

Quotidian Estivoautumnal Fever; Malignant Malaria (*Hæmamaeba falciparum* [*quotidianum*]).—Occurring with the daily sporulation of the parasites, the *paroxysm* is characterized by more or less severe chill and profuse sweat, with constitutional disturbances similar to those described in the preceding section. The temperature curve, however, shows abrupt rise and abrupt fall. The attack lasts some eight or ten hours. Not rarely, the fever assumes a remittent, subcontinuous, or irregular type, as paroxysms merge into one another more or less closely. The discrimination from typhoid fever is here also difficult and important.

PERNICIOUS MALARIA.

From the suddenness and severity of their symptoms, and from their high mortality, certain forms of malaria are termed *fulminant* or, more commonly, *pernicious*. The term *malignant*, formerly used synonymously, has now been extended, improperly, to all fevers caused by crescent-forming organisms (*estivoautumnal fevers*).

VARIETIES.—Pernicious forms of malaria are classified in two ways: 1. According to the temperature curve, as *tertian*, *quotidian*, *remittent* or *larval* forms. 2. According to the character of the clinical manifestations, as of the *comatose*, *delirious*, *tetanic*, *gastric*, *dysenteric*, *choleraic*, *algid*, *pneumonic*, *hemorrhagic*, *cardialgic*, and *bilious* types.

The chief clinical forms will here briefly be considered.

SYMPTOMS AND DIAGNOSIS.

—The pernicious character of the attack may be evident from the first, or may show itself only after two or three paroxysms.

Coma may appear in two ways, as follows:—

1. With *sudden* onset, so sudden in fact, that the patient—often one who has suffered from previous infections of milder type—is stricken and falls to the ground, perhaps to die before regaining consciousness. This type is not rarely mistaken for apoplexy. The face is suffused, the skin hot and dry, and the pupils contracted. Full, bounding pulse and stertorous breathing complete the resemblance. The temperature may be relatively high (103° F.), or subnormal, and death may ensue within forty-eight hours.

2. With *gradual* oncoming, after more or less severe paroxysms. Delirium, restlessness, and mental depres-

sion are more than commonly marked, and the patient slowly passes into somnolence, progressing to coma. In certain cases the icteric hue of the skin and the yellowness of the conjunctiva may give rise to a mistaken diagnosis of yellow fever. In those suffering from chronic malarial anemia a peculiar pallor may be present.

In the typical attack the skin is hot and dry and may exhibit slight punctate hemorrhages (petechiæ). The pupillary symptoms are not constant. The tongue is coated and tremulous. Respiration is slow and quiet, but may become quickened and stertorous; toward the end it may assume the Cheyne-Stokes type. Sphincter control is lost. Paralysis or hemiplegia may follow. A full bounding pulse becomes rapid, irregular, and weak. As a rule, the patient rapidly passes into general collapse, and death shortly ensues. Sometimes, however, a period may follow in which the temperature falls, profuse perspiration takes place, and to all appearances the patient is slowly gaining, when a second, or perhaps a third paroxysm supervenes, and terminates fatally. The gradual form of coma, whether continuous or intermittent, may last from two to four days. While it is attended with a high mortality, recovery, at times surprising, may take place.

The temperature curve varies. It may be high or low—even subnormal—and corresponds to no type. 112° F. and 96° F. have both been recorded. In all cases a blood examination should be made at the earliest possible moment.

In either form of comatose attack, certain muscles may be the seat of local spasm, giving rise to jerking or contractures of the limbs, trismus, deviation of the eyeballs, etc.

Among other cerebral types that may be mentioned are the *delirious* form, characterized by hallucinations or maniacal excitement; the tetanic or *eclamptic* form, characterized by convulsions, and common in children, in whom it may be mistaken for cerebro-spinal meningitis; the *hemiplegic* form, characterized by complete monolateral or even bilateral paralysis; the *cephalgic* form, with profound headache, which may be confounded with meningitis, typhus or typhoid fever, etc.

Algid Form.—This takes its name from the marble coldness of the body. It is one of the most fatal of the pernicious types. The characteristic symptoms may develop after one or more paroxysms of common type, during the febrile or sweating stage, or they may initiate the entire reaction.

A characteristic "Hippocratic facies, with sunken eyes, dilated pupils, drawn face, and pinched nares, may be presented. The entire body is cold, pallid or cyanotic, and bathed in a profuse cold sweat. The tongue is dry and cold, and coated with a white fur. The pulse is rapid, thready, compressible, and intermittent. Respiration is shallow and irregular. The abdomen is retracted, and the enlarged spleen becomes readily palpable or even visible. The mind may be clear, but the patient is apathetic, and the heart sounds inaudible. As death approaches the pulse becomes imperceptible. Unaware of the increasing coldness of the body, the patient complains of heat. Rectal temperature is elevated. Death supervenes in a few hours, despite heroic treatment.

Syncopal Forms.—Closely allied to the algid form is the condition in which even the slightest exertion of the pa-

tient as turning in bed, or lifting the hand, brings about a syncopal attack. Symptoms of collapse dominate the picture, and even should the patient come safely through one paroxysm, a succeeding crisis, unprevented by treatment, may carry him into the great unknown.

Of kin to the algid type is likewise the *sudoriferous* form. At the end of the febrile stage, excessive and prolonged sweating occurs, accompanied with symptoms of collapse, usually fatal.

Choleric form Type.—In this type, gastroenteric symptoms, with a tendency to algid phenomena, give rise to a symptom-complex so closely resembling the algid stage of Asiatic cholera, that in climates where both exists, only a blood examination or bacteriologic study can differentiate between them. Active treatment is usually followed by recovery. The principal symptoms are vomiting, profuse diarrhea, and fever. The diarrhea leads to profound collapse, with the usual train of phenomena. The stools are liquid, flecked with blood, and like the rice-water stools of cholera. Severe abdominal pain and cramps in the extremities are common. Death ensues in inadequately treated cases.

Another form, marked by loose, blood-stained discharges from the bowel, is the *dysenteric* type, observed in tropical climates. Algidity and collapse are wanting, and when properly studied and treated, the condition usually clears up.

In the *bilious* form, a symptom-complex of jaundice, vomiting of bile and blood-stained fluid, accompanied by epistaxis, frequently hematemesis, and serous, bile-stained, or bloody alvine discharges, follows a well-defined

paroxysm. The temperature becomes more or less remittent, and continuous delirium or even coma, may develop. Severe epigastric or abdominal pain, constant hiccough, and at times tympanites, add to the distress. The urine is scanty and deeply discolored. Untreated, the patient will succumb. Active therapy usually brings about recovery.

The *cardialgic* and *gastralgic* form is distinguished by severe, often agonizing, pains in the epigastrium occurring during the chill or febrile stage of the paroxysm and mitigating toward its end. The pain may be referred to the spinal column. The attack is often accompanied by an oppressive sense of thoracic fullness, hiccough, vomiting, and hematemesis. Intestinal symptoms may be associated. Collapse may ensue, with its usual train of symptoms.

Hemorrhagic types are relatively infrequent. As the name implies, they are characterized by bleeding, which may be the only unusual phenomenon, or may complicate any of the other syndrome groups. The hemorrhages may occur anywhere, and be slight or overwhelming. Their chief incidence is perhaps from the nasal, gingival, buccal, alimentary and respiratory mucous membranes; but hematuria, and conjunctival and retinal hemorrhages are not unknown.

Pneumonic and Pleuritic Forms.—The chief symptoms are thoracic pain, dyspnea, cough, and not rarely hemoptysis or bloody sputum. Physical signs are not constant. At times percussion resonance may be unimpaired, while auscultation reveals merely showers of fine bronchial râles, extensively diffused, but without bronchial breathing. At other times there is distinct localized or disseminated dull-

ness, indicative of congestion and blocking of the lung capillaries. The characteristic phenomena may appear suddenly or develop in the course of what seems to be one of the milder forms of attack. They may clear up suddenly and as suddenly reappear. This intermittence and recurrence, often periodic, is the chief diagnostic sign by which an actual complication by lobar or lobular pneumonia may be excluded.

ETIOLOGY.—The pernicious forms of malaria depend upon the same organisms as the milder forms, but the great preponderance of fatal cases is caused by the estivoautumnal (crescent-forming) parasites, and of these the tertian parasite is the chief offender. It is generally believed that the infecting organisms develop toxins of unusual potency. Heat and exhaustion, however, are powerful contributing causes.

Bastianelli and Bignami, confirmed by Bass, attribute pernicious symptoms to a localization of the parasites in the brain or other organs. Frequently the lumina of the capillaries are occluded with infected red cells, pigmented leucocytes, free pigment masses and débris. At times, and particularly in the bowel, necrosis and ulceration ensue. The virulence and number of the infecting organisms, and the resistance and environment of the patient also affect the result.

In temperate climates the few cases that occur usually appear in summer or autumn. The morbidity increases (in number as well as duration) as the torrid regions are approached, while in the tropics and subtropical regions pernicious malaria may occur throughout the year.

Certain classes of persons seem more susceptible than others:—

1. Individuals who have suffered from repeated attacks of malarial infection and have not been properly treated, especially those who neglect quinine prophylaxis.

2. Those whose work exposes them to the torrid rays of the sun for long periods. They are especially liable to the comatose form.

3. Strangers to malarial districts.

4. Alcoholics.

5. Persons who are ill nourished, and especially sufferers from acute or recurrent disorders of the alimentary tract. These may develop choleraic and dysenteric syndromes.

LATENT AND MASKED MALARIA.—A latent malarial infection is one in which the parasites, though present in the system and frequently found in the blood, give rise to no distressing symptoms; while a *masked* infection is one in which the symptoms are either (1) atypical, or (2) obscured by the symptom-complex of a concurrent ailment, usually another infection. The crescent-forming parasites seem to be responsible for the majority of cases.

Urobilinuria is a symptom easily observed, which indicates latent malaria after the disappearance of other signs. The writer uses Schlesinger's method, which is as follows: To the unfiltered urine add an equal quantity of a solution of 10 parts of zinc acetate in absolute alcohol in a test-tube. Shake it well and add a few drops of Lugol's solution, stirring it again. Afterwards the filtered mixture shows fluorescence more or less intensively according to its content of urobilin. Plehn (Brit. Med. Jour., Oct. 31, 1908).

Few practitioners realize how closely malaria can mimic other diseases. In a tropical town a man arrested because he is extremely noisy and apparently drunk may next morning be

found very ill or dying and the blood examination show many subtertian parasites, indicating pernicious malaria. A man brought to a hospital in a stuporous or melancholic condition, with normal or subnormal temperature, may be considered a lunatic, but a blood film leads to the true diagnosis of pernicious malaria. A man never known to have malaria, attending a concert, slipped off his chair, unconscious, and was thought apoplectic; a blood examination showed malarial parasites. Pernicious malaria may produce a clinical picture by no means unlike cerebrospinal meningitis. A boy aged 12 was brought to a hospital, unconscious, with dilated pupils, very slight corneal reflex, involuntary passage of urine, twitching of the fingers and toes, rectal temperature 103°, tongue coated, and spleen enlarged. Lumbar puncture was negative but subtertian parasites were found in the blood. In another case, a male aged 25, the malarial condition resulted in acute mania so violent that the patient had to be put in chains and under guard. Under repeated 10-grain injections of quinine bihydrochloride he recovered in 14 days. Kamar (Jour. of Trop. Med. and Hyg., Dec. 15, 1917).

Some cases may be termed both masked and latent, *i.e.*, the patient is free from symptoms for long periods, and then develops symptoms which are not, on the surface, suggestive of malarial infection.

[Thus in 1 case observed by the senior writer there had been for twenty years annual recurrences of severe gastroenteric disturbance, with nausea and vomiting, or with anorexia especially marked. Careful search, based upon the history of annual periodicity, failed to discover parasites in the peripheral blood, but upon the administration of 0.5 Gm. (8 grains) of quinine and urea hydrochloride subcutaneously they appeared, at first in small numbers, then rapidly multiplying. Continued, adequate medication was followed by recovery from the attack, but in the following autumn recurrence took

place as usual. The same experience was repeated: (1) No organisms discoverable; (2) appearance of crescent-forming parasites in blood-stream after small dose of quinine; (3) recovery upon adequate use of quinine. This time, however, the use of quinine was continued for six months, and arsenic was also given from time to time. Quinine was then resumed a month earlier than the time of annual recurrence, and continued for three months. After that no further trouble was experienced. S. SOLIS-COHEN AND L. SOLIS-COHEN.]

In some cases, a semiannual periodicity has been observed. Altogether, in thirty years, the senior writer has seen about a dozen such cases; but in highly malarious regions they must be more common, and it is strange that they have received comparatively little attention from writers and students.

In *unmixed masked malaria*, *i.e.*, infection with atypical symptoms, the morbid picture may be febrile or afebrile, with local or general disturbances. As a rule, careful observation will detect more or less regular periodicity of manifestation, or a tendency to periodic crises. Myalgias, arthralgias, cephalalgias, and neuralgias are among the most common varieties; but visceral disturbances, often painful and critical, often occur. The so-called "brow-ague" often assumes the type of *sun-pain*, *i.e.*, pain in and over the eyes, usually accompanied by tenderness on pressure at the supraorbital or infraorbital notch, or both, appearing in the morning, and disappearing at sundown. It may be unilateral or bilateral, and may appear daily or on alternate days, weekly or fortnightly, or irregularly.

There are cases of malaria in which the sole clinical manifestation is some symptom not ordinarily considered

characteristic of the disease, together with a very moderate degree of intermittent or continuous fever and the constant presence of black, blue, as well as sometimes of ochre pigment in the blood and urine. This larval type of malaria does not follow ordinary acute paroxysms, but appears *ab initio*. No plasmodia are to be seen in the blood at the time. Among the various forms it may assume, the following have been carefully studied by the author and found related to the appearance of the pigments in the urine: (1) Sensation of cold in the lower limbs and back; (2) edema of the extremities or face; (3) trigeminal or intercostal neuralgia; (4) peripheral neuritis with paraplegia of the flexor variety; (5) attacks of dizziness, and (6) pain in the epigastrium, with or without periodic vomiting or enlargement and tenderness of the spleen and liver. With each of these manifestations may be combined anemia, anorexia, malaise, sweating, and slight fever, all showing a tendency to periodicity. The black pigment is always abundant in the urine and is easily seen microscopically, provided the slide be moved around to set the pigment particles in motion. The blue particles are equally pathognomonic, but are much fewer in number and usually smaller than the black. Ten cases illustrating the various forms of larval malaria are reported. Recovery always followed the use of a **cholagogue**—not specified—or small doses of **quinine**, for a few weeks. The writer holds that many cases of so-called beriberi in Panama, whence he writes, represent in reality the neuritic form of larval malaria. C. L. Urriola (N. Y. Med. Jour., from Paris méd., Oct. 25, 1913).

Whatever the type of infection, the organisms are found in relatively small numbers, but in all stages of development. In some cases of latent infection a complete cycle of the malarial organism within the spleen, has been demonstrated *post mortem*.

Among the **concurrent**—*i.e.*, mixed—infections that may *mask* malaria or *be masked* by malaria, the most common are tuberculosis, dysentery (amebic or bacillary), and typhoid fever.

It can readily be seen that malaria carriers (whether subjects of latent or masked infection or both) are a source of perennial danger to any community living in a region infested by *Anopheles* mosquitoes. Henson enters a justifiable plea that more attention be paid to prophylaxis from the viewpoint of man as an infective focus.

COMPLICATIONS AND SEQUELÆ.—**Complications.**—The complications of malaria are for the most part accidental; *i.e.*, they arise from pre-existing disease or mixed infection, and are not a necessary result of malarial intoxication. Sometimes, however, they may be the result of purely mechanical causes, as when circulation is obstructed by infected cells, *débris*, etc.

Acting upon the nervous system, malarial toxemia may give rise to cephalalgia, neuralgia, neuritis,—often multiple,—or acute mania. Paraplegia, hemiplegia, and other paralyses are more frequently of mechanical origin.

When malaria attacks the brain, it may simulate any form of cerebral disease, but in a general way three types may be recognized. These are: (1) The comatose, characterized by coma as the dominant symptom, appearing suddenly after repeated malarial attacks. It is usually quite pronounced, there being no response to stimulation, and may last only a few hours, disappearing with the sweating stage, or may continue several days, or gradually deepen till death. The temperature is high—103° to 105° F.

(39.4° to 40.5° C.). (2) The motor irritative type, also with coma, but characterized by marked motor symptoms ranging from muscular twitchings to clonic convulsions. It may simulate uremia, hysteria, or tetanus. (3) The motor depressive type, which is rare. It may cause monoplegic, hemiplegic or paraplegic paralysis, usually subsiding with the paroxysms. In the majority of cases any mental disturbance quickly disappears, but occasionally confusional symptoms continue for a time. In all cases the estivoautumnal organism is the cause. J. F. Patterson (Jour. Amer. Med. Assoc., Nov. 15, 1913).

Report of 3 cases of malaria in which cerebral symptoms as well as skin manifestations were so prominent that diagnosis of malaria was made only after repeated examination of the blood had determined the presence of parasites. In 2 cases severe headache and an urticarial eruption of the skin were the chief symptoms, while in the third case intense headache was followed by jaundice, which cleared up only after the administration of methylene blue. W. Ettinger (Wiener klin. Woch., Jan. 15, 1914).

Acute bronchitis is the most common respiratory complication of malarial infection. Lobar pneumonia, however, is not uncommon, and is a secondary infection, not due to the malarial parasite, as formerly supposed. Malaria may diminish the resistance to pneumococcic or other infection, but there is no other relationship between the original and the complicating malady. Pneumonia may mask the malarial symptoms, or the reverse may be the case. Ordinarily, however, the course and symptoms resemble those of uncomplicated lobar pneumonia with perhaps an impression of recurrent tendency to chill and fluctuation of temperature. The prognosis is necessarily grave.

Bronchopneumonia occurs less frequently than the lobar form and may be produced by the plasmodia. Chronic fibroid pneumonia may supervene. Pleurisy has been observed as a concurrent infection.

Out of a total of 115 cases of malaria treated by the writer during an epidemic of influenza, 112 suffered from the latter disease. Of the 50 in which pulmonary complications occurred, 42 or 36.52 per cent. died, even though quinine had been exhibited in large doses. Colalè (Policlinico, Jan. 26, 1919).

Tuberculosis and malaria may co-exist. Marchiafava states that when tuberculous patients contract malaria, miliary infection is likely to be the result. These observations have been confirmed by Craig.

Organic disease of the heart may complicate malaria and functional disorders are not uncommon. Bradycardia and tachycardia have been observed.

Albuminuria accompanies rather than complicates malarial infections. Thayer reports 46 per cent. of instances and Craig 50 per cent. Acute, subacute, or chronic nephritis may complicate as well as supervene upon a malarial infection. Orchitis and epididymitis may occur. Mannaberg also reports gangrene of the penis and of the labia.

Malaria may be considered a direct or a provocative agent of symmetrical gangrene. The skin lesion differs somewhat from the classical description of Raynaud. E. J. Wood (Jour. Amer. Med. Assoc., Dec. 7, 1907).

The most common of gastroenteric complications is dysentery in both its bacillary and amebic forms. This co-existence is common in the tropics. The dysenteric symptoms are always aggravated by the malaria, which

may remain latent. Quinine ameliorates both processes.

Typhoid fever and malaria frequently coexist. Deadrick records from the literature 215 cases in which the presence of parasites and bacilli, together with a positive Widal reaction, were demonstrated. The organisms were chiefly of the ordinary tertian type, but crescent-forming parasites were found also, and the senior writer has seen a number of such cases. Craig has reported the only case of quartan infection complicated with typhoid of which the writers have knowledge. The old idea that a hybrid disease (so-called typhomalaria) is produced, is incorrect. The condition is one of concurrent infection. The malaria may occur primarily, may appear during convalescence, having been latent, or may even be acquired during the course of typhoid fever. In all cases the prognosis is rendered more grave by the double infection.

The effect of malaria upon pregnancy is important. In malarial districts, a latent infection is likely to flare up during gestation and to produce premature labor. This may be one of nature's protective processes. Henson has observed abortion in one-fourth of the cases of estivoautumnal infections complicating pregnancy. During the puerperium malaria may cause considerable difficulty in diagnosis, unless the blood is examined in order to differentiate it from septic infection.

Infants less than a year old seem to display resistance to malaria, both against acquiring it and against its effects. Malarial cachexia was observed to occur most frequently between the ages of 3 and 7; if children thus affected survive, they acquire

•
durable immunity. The spleen is not always enlarged even in these severe cases, and the anemia is not always intense. Various types of the hematozoa were found combined in the blood in some cases. Gastrointestinal disturbances were the main complication of malaria in children, but the blood findings were negative in 92 cases of febrile diarrhea ascribed at first to malaria. Malarial nephritis has scarcely ever been observed in a child, but epistaxis, purpura, vomiting of blood, cirrhosis, urticaria, and ascites are frequent complications, as also convulsions and delirium. J. P. Cardamatis (*Grèce médicale*, May 15, 1909).

Among 30,000 cases of malaria admitted to the Colon Hospital during eight years, only 3 instances of spontaneous rupture of the spleen were noted. Conclusions: Spontaneous rupture of the malarial spleen occurs in rare instances; the organ does not necessarily have to undergo a great degree of enlargement for spontaneous rupture to occur; very deep palpation or forcible percussion of the enlarged malarial spleen should be avoided; exploratory puncture of the spleen for diagnostic reasons is not without danger; the treatment of spontaneous rupture is early **tamponade** or **splenectomy**. Noland and Watson (*Annals of Surg.*, Jan., 1913).

Sequelæ.—The sequelæ of malaria may be manifested in any or in all of the organs and tissues of the body. Only those affections, however, can rightly be classed as sequelæ which are owing to the toxins generated during the active stage of the disease, to the hemolysis, or to the mechanical interference with circulation by the blocking of the capillaries, and which manifest themselves after the subsidence of the exciting infection. This point cannot always be clearly established, and in some cases de-

scribed as of postmalarial disorder, the plasmodia can still be demonstrated. Recovery, indeed, may depend on their discovery and their consequent treatment by quinine. We shall not here attempt to discriminate between true sequelæ and symptoms developing under continuous infection after the disappearance of paroxysms.

Nervous sequelæ are most numerous after estivoautumnal infections, but may follow the course of other infections. J. M. DaCosta, of Philadelphia, was the first to report a case of hemiplegia. Mannaberg describes cases of aphasia, monoplegia, and paraplegia. Conditions closely simulating multiple sclerosis have been observed by Torti, Bignami and other observers. Multiple neuritis and peripheral nerve disorders, neuralgias, and neurasthenic conditions are likewise reported.

Among *mental disorders*, melancholia, mania, and delusional insanity sometimes occur as postmalarial phenomena. Craig found a mild melancholia to be the most common mental affection following malarial fever.

When the blood-findings are positive, the nervous and mental phenomena show rapid and marked improvement under quinine, complete recovery being the rule.

Upon the heart and blood-vessels, according to common and authoritative opinion, malarial toxins rarely have sufficient effect to cause sequelæ of serious import. The senior writer, however, has observed cardiac myopathies that he could attribute to no other cause.

A true acute or chronic ulcerative enteritis and, although rarely, gas-

tric ulcer, may result from a localization of the parasites in the mucosa of the gastroenteric tract.

Kelch and Kiener describe both acute and chronic glomerular nephritis, and likewise, acute and chronic granular nephritis. The glomerular types give rise to chronic parenchymatous nephritis, and the granular type to subacute and chronic interstitial nephritis. In 112 cases of acute nephritis of all types, Thayer observed 21 (or 18.7 per cent.) of malarial origin. In 1832 malarial sufferers, the same observer noted 4 cases of chronic nephritis.

Albuminuria, with few or no casts, is also of common occurrence. Amyloid degeneration, polyuria, and glycosuria have been reported in rare instances.

Estivoautumnal infections give rise to the majority of the kidney lesions. Craig observed that 3 per cent. of all estivoautumnal fevers are followed by nephritis, but that the latter is very rare (0.5 per cent.) after quartan and ordinary tertian cases.

Hypertrophic malarial hepatitis has been reported as following repeated estivoautumnal infections. It seldom gives rise to clinical trouble. The senior writer and others have recorded cases of biliary cirrhosis, pursuing the usual course, with splenic enlargement. It is a disputed point whether a true atrophic cirrhosis of the liver exists as a malarial sequel, as the affection is found in about the same proportion of persons in malarial districts as elsewhere.

Floating or wandering spleen and abscess of the spleen occur infrequently. The enlarged spleen or ague-cake, often associated with enlarged liver, is common. Cases of splenome-

galic anemia with hemorrhage and leucopenia, in all respects resembling Banti's disease, have been observed in persons who had recovered from malaria, but Osler would exclude them from the category of malarial sequelæ. In one such instance in the senior writer's service, his quinine method caused the appearance in the peripheral blood of organisms recognized by R. C. Rosenberger as atypical malarial hemamebæ.

Orchitis and epididymitis have been reported by Ziemann. These are of rare occurrence.

Among the eye affections that follow malaria are amaurosis and retinochoroiditis; but these are sometimes attributed to the quinine. Keratitis and suppurative choroiditis have likewise been observed.

Intermittent otalgia, intermittent deafness, labyrinthine vertigo, and suppurative otitis media are among the ear affections observed.

Post-malarial anemia may be very grave, sometimes closely resembling pernicious anemia. It may be uncomplicated or form part of the complexus known as *malarial cachexia* (*q.v.*). Severe secondary anemias frequently follow both ordinary and estivoautumnal infections, but as a rule, yield readily to arsenic and iron.

PATHOLOGY.—Acute Malaria.—As the benign malarial infections seldom lead to autopsy, our knowledge of the pathological changes induced by malarial fevers is based chiefly upon observation of the pernicious and estivoautumnal types.

The writers hold that the adrenals are responsible for the attacks of coma, the algid and other choleriform symptoms of pernicious malaria, these organs showing acute hemor-

rhage and degeneration. Paiseau and Lemaire (*Presse méd.*, Dec. 4, 1916).

In the Salonica Army, sudden death or early death was common, 57 per cent. dying within the first 48 hours after admission. The adrenals showed most marked changes. Dudgeon and Clarke (*Lancet*, Aug. 4, 1917).

The writer observed 3 cases of malaria indicating acute insufficiency of the adrenals, and urges the use of **adrenalin**. Fraga (*Revista Ibero-Am. de Sc.*, July, 1918).

Of these changes, *melanemia*, or the widespread intravascular deposition of a pigment termed melanin, is the most striking. Melanin is a product of hemoglobin elaborated by intracorpuseular parasites in the course of their destructive activity.

Melanin must not be confused with hemosiderin, an ochre-colored pigment found in the tissues, and which is derived from the hemoglobin of corpuscles not attacked by the parasite. It occurs in the form of dark brown or black granules, which tend to clump when situated in the viscera. When liberated by the completed segmentation of the sporulating parasites, it is largely taken up by the leucocytes and by them deposited principally in the capillaries of the brain, liver, spleen, and bone-marrow.

Occasionally melanin is found free in the blood or in the tissues, which latter it can reach only by diapedesis of the leucocytes or rupture of the capillaries. Hemosiderin, on the other hand, is found only within the tissues. It is deposited in the liver, kidneys, spleen, and bone-marrow in the form of yellow granules, clumps, or small ochre-colored masses. In contrast with melanin, it is found within the endothelial cells and Kupfer's liver cells.

[Melanin is insoluble in strong acids, but soluble in ammonium sulphide, and is decolorized by potassium and ammonium salts. No trace of iron has yet been demonstrated in it.]

[Hemosiderin gives an iron reaction to the ferrocyanide test, and turns black when treated with ammonium sulphide. It is insoluble in strong acids and alkalis, alcohol, and water.]

The degree and extent of the melanosis largely depend on: (1) the type of the parasitic infection; (2) its virulence, and (3) the distribution of the parasites. Thus in quartan infection, the parasites are found chiefly in the peripheral blood-stream. The internal organs are the chief habitats of the parasites in the estivo-autumnal types, while in the simple tertian fevers the plasmodia are found in large numbers in both the internal organs and the peripheral blood. Naturally, numerous parasites, giving rise to an overwhelming infection, will tend to a greater red-cell destruction and elaboration of abundant pigment. In accordance, also, will more or less extensive retrograde changes ensue in the tissues and organs generally.

Cases of malarial splenic enlargement may occur in the absence of all fever. This condition doubtless often escapes notice. In 2 of the author's 16 cases the patients came under treatment for disorders other than malaria, and the splenic enlargement was only discovered by chance. Porak (*Presse méd.*, Apr. 22, 1918).

The distribution of malarial pigment throughout the organs gives rise to the characteristic striking slate-gray color noticed by such early observers as Laveran, Stoll, and Bright.

The *spleen* is enlarged, sometimes enormously so, especially in pro-

longed and repeated infections. It is discolored, the hue varying from a light chocolate to jet black. The capsule is tense, smooth, and may even rupture. The cut surface drips blood; the pulp is soft; the Malpighian bodies may stand out prominently. In very recent infections and in the estivoautumnal types, the splenic enlargement is often slight. Microscopically, the sinuses are congested and dilated, containing numbers of plasmodia in all stages of development, including crescents. Numerous large mononuclear and polynuclear cells (macrophages), laden with pigment, are also found. The small lymphocytes, Malpighian bodies, and endothelial cells may contain slight amounts of pigment. Free pigment is found throughout the parenchyma.

Areas of focal necrosis are sometimes observed. The connective tissue is likely to be increased in repeated and chronic infections. Thrombosis in the splenic sinuses from congestion and massing of pigment are not uncommon.

The *kidneys* rarely show evident pigmentation, except in cases of black-water fever, in which both pigmentation and hemorrhage are marked. Ordinarily, there is slight enlargement and the smooth capsule is easily stripped. Sometimes the kidney resembles that of acute nephritis, with small punctate, cortical hemorrhages. Congestion may be present, with cortical enlargement. Microscopically, the epithelium shows a slight pigment content. Casts and amorphous masses may be found in the tubules. The glomeruli and intertubular capillaries may contain melanin, a few parasites, leucocytes,

and macrophages. Signs of an acute nephritis may also be present.

The *liver* is commonly enlarged and congested. The hyperemia is responsible for much of the increase in weight. Pigmentation gives to the organ a brown or blackish color. The gall-bladder is distended with dark bile. The cut section exhibits a markedly congested surface of a slate-gray color.

Microscopically, the capillaries of the portal and hepatic veins are found to contain parasites, and parasites and splenic macrophages are found in the portal veins as well. The endothelial cells and Kupfer's cells contain pigment. Barker has observed areas of focal necrosis from capillary thrombosis. The cells of the parenchyma undergo retrograde changes, becoming swollen, vacuolated, atrophied, and necrotic.

The only change in the liver due to the malaria itself is an increase in size. Functional disorders, if of any gravity, are due to other causes, such as alcoholism and poor nutrition. Fraga (*Revue de méd.*, vol. xxiii, No. 10, 1913).

Bone-marrow changes depend on the severity and duration of the infection. The yellow color of normal marrow is preserved in recent infections, but changes to red or black in prolonged cases which tend toward chronicity. Microscopically, parasites including sporulating bodies, and crescents, a few pigmented macrophages, and erythrocytes, are found in and around the capillaries.

The *brain* shows few changes, except in infections of long standing, or those characterized by meningeal symptoms. There may be marked discoloration of the cortex, with congestion and punctiform hemorrhagic

areas. In comatose cases, parasites in all stages of development, together with macrophages and erythrocytes, are found in the capillaries.

In the *gastroenteric* tract, the most marked changes are manifested in choleraic and allied types of infection. As shown by Bignami, the attacking parasites may be localized in the intestine. The capillaries become infected and contain free or inclosed parasites, phagocytes, and pigmented macrophages. Thrombosis and even ulceration may result. Ordinary cases will show only pigmentary changes.

In the *lungs*, non-pigmented areas of bronchopneumonia and infarction may be found. The alveolar capillaries may be blocked with parasites and macrophages, while the endothelial cells contain pigment.

The *heart* ordinarily exhibits but slight changes. The muscle may be pale, flabby, or even show fatty degeneration. The capillaries of the muscular wall may contain parasites and macrophages.

The changes in the *blood* as observed both during life and after death may briefly be summarized as follows: (1) A marked reduction in the number of red corpuscles, brought about (a) directly by parasitic invasion (b) as the result of poisons elaborated by the parasites during their development (c) through changes in the blood-forming glands; (2) a corresponding reduction in the number of white cells, with, in most cases, a relative increase in the large mononuclear leucocytes; (3) a marked reduction in the hemoglobin; and (4) the presence in the plasma of black and brownish-yellow pigment, in greater or less amount.

After acute initial attacks of malarial fever there occurs a rapid loss of hemoglobin and red blood cells. The hemoglobin loss, in two or three months of irregular fever, may take place to an amount of from 40 to 50 per cent. of the normal, and the reds diminish to the extent of from 2 to 2½ millions to the cubic millimeter. After the attack is cut short by treatment the recovery in these blood elements is likewise rapid. J. P. Bates (Jour. of Trop. Med. and Hyg., July 1, 1913).

Chronic Malaria.—The most important structural changes are found in the liver, spleen, and bone-marrow.

The *spleen* is usually considerably enlarged, its capsule being irregularly thickened and in places calcified. The organ is more or less hardened. Its color may be red, grayish brown, or slaty. The cut surfaces show grayish trabeculae formed of the thickened connective-tissue stroma and vascular sheaths. The remarkable dilatation of the veins may simulate angiomata. The Malpighian bodies are ordinarily not prominent. The microscopic findings differ as the change progresses from the small, soft spleen to the "ague-cake." With the marked diminution in hyperemia which follows subsidence of the acute process, there develop miliary necrotic areas and extensive hyperplasia, involving the pulp and often the follicles. The pigment is less widely distributed and tends to become concentrated about the vessels and in the fibrous septa. Later, the macrophages which were its carriers disappear, and the pigment is found only extracellularly, in the perivascular lymph-spaces; and gradually it is completely reabsorbed.

The necrotic areas slowly undergo reabsorption; but the connective tissue hyperplasia, the vascular

dilatation, and the atrophy of the parenchyma increase. The follicles eventually become unrecognizable through fibroid degeneration. The ague-cake consists chiefly of thickened stroma and dilated vessels with but a minimum of pulp cells and follicles, and with corresponding loss of physiological function (Bignami).

The *liver* is enlarged and of increased density. The surface is smooth, the capsule thickened. The cut surfaces are irregularly pigmented in recent infection, becoming arranged as a perilobular network in long-standing cases.

Microscopically, in early cases, the capillaries are free from parasites, the endovascular macrophages have likewise disappeared, and the pigment is found only in the endothelia and in Kupfer's cells. The necrotic portions of the lobules atrophy, and the vessels dilate in consequence. Later, the pigment disappears from the lobules, being carried to the periphery by mononuclear and polymorphonuclear leucocytes which deposit it in the perivascular lymph-spaces. At the same time regenerative changes are occurring in the liver cells and the perilobular connective tissue becomes hyperplastic. In long-standing cases, therefore, there is a large hard liver of reddish color, which, on section, shows conspicuously the granular-looking lobules, surrounded by their connective-tissue stroma. The vessels are dilated; the amount of blood in the organ is increased, and the pigment is no longer visible (Bignami).

The *bone-marrow* at both the upper and the lower extremities of the long bones is red and of increased consistence. Microscopically (Bignami),

the fat has disappeared and is replaced by proliferated marrow-cells and new blood-vessels. The large and small mononuclear myelocytes are increased, and many show signs of degeneration. In addition there are numerous nucleated red blood-corpuscles of normal size (normoblasts), and a few giantoblasts or megaloblasts. The endothelium of the vessel is swollen, and the vessel walls and the stroma are thickened. The pigment disappears from the bone-marrow much sooner than from the other organs.

DIAGNOSIS.—Although clinical phenomena are important, and should be observed carefully, the diagnosis of malarial fevers today, depends chiefly upon the blood-findings. The so-called "therapeutic test" as ordinarily applied for purposes of diagnosis is rapidly passing into deserved disrepute. The observation that fevers yielding to quinine are not all malarial infections has been abundantly confirmed by clinicians of the largest experience. On the other hand, such fevers do not show the prolonged "freedom-period" characteristic of uncomplicated malaria when quinine is properly employed. Hence a certain amount of dependence may be placed upon an expedient used by the senior writer for some twenty-five years. Intramuscular injection of 1 Gm. (15 grains) of quinine and urea hydrochloride will in most cases of malarial fever be followed by freedom from paroxysms, and by reduction of temperature to or below the normal line with but slight fluctuations, for a period of about six and one-half or thirteen days. Rarely have more than 2 injections on successive days been

necessary. Failure to manifest this period after 3 or 4 such injections indicates the presence of some other infection. Ianni has had similar results from the use of strychnine. A single dose of $\frac{1}{20}$ grain has been followed, in an hour or so, by the appearance of parasites in the peripheral blood. Blood tests should be made carefully and often. Both fresh and stained specimens are to be examined.

The blood may be obtained either from the finger or the lobe of the ear, and should preferably be taken either during a chill or a short time before it. In using an unstained specimen, a drop of blood is placed on a well-cleaned cover glass and the latter gently dropped on a clean slide. Under the oil immersion objective a few of the red corpuscles will be observed to show small hyaline bodies, moving in ameboid fashion and containing, in turn, minute masses of pigment, in active Brownian motion. These movements later cease. Stained preparations are made by spreading a thin film of blood on a cover glass, fixing by rapid passage of the cover glass through a Bunsen flame, and staining with Wright's stain. A clearer view of the parasites is thus obtained, except in the case of the sexual forms (gametocytes and microgametocytes or flagellate bodies), which are seen only in unstained preparations, and after these have been watched under the microscope for some minutes. There are many pitfalls into which one unskilled in technique may fall. The reader may advantageously consult the larger special works on laboratory diagnosis for additional refinements of procedure.

When the examination reveals the hemameba and its type, the diagnosis of malaria is certain, but mixed infection is not necessarily excluded. Pigmented mononuclear or polynuclear leucocytes are likewise positive evidence of a malarial infection, past or present. The value of a differential blood-count showing a mononuclear hyperleucocytosis is disputed, but it may be accepted as confirmatory, though not conclusive, evidence.

When parasites are absent from the peripheral blood, they may be found in blood withdrawn from the spleen; but splenic puncture is not to be lightly undertaken, and should, in any event, be entrusted, if possible, to an experienced observer. It is better, first, to try the senior writer's method of driving the parasites out of covert by the injection of a subtherapeutic dose (0.3 to 0.5 Gm.—5 to 8 grains) of quinine and urea hydrochloride.

This method, while sometimes of service in acute fevers, is chiefly applicable in the chronic type of latent and masked cases, and frequently the organisms found upon the slide, while recognizable as forms of the hemameba, are atypical in various respects. The reaction, however, has occurred so frequently that one is inclined to look upon the absence of organisms after half a dozen injections in increasing doses from three to six days apart as virtually excluding malarial infection. Apparently in these cases the parasites are resting in a larval form, lurking in the spleen or bone-marrow, and by reproductive reaction to the paratoxic effect of quinine, they make their appearance in the peripheral

circulation. The more recent observations of Celli and of Craig go far to confirm this long-announced opinion.

An impoverished condition of the blood—*i.e.*, low erythrocytosis with low hemoglobin content—must be taken in conjunction with the other facts obtained, and too much stress should not be laid upon anemia alone.

Clinically, the regularly recurring paroxysms and the orderly sequence of the various stages shown in an *ordinary* single or double *tertian* or *quartan* infection, together with the physical findings, are commonly sufficient to justify the diagnosis of malaria.

The irregularities frequently manifested by the *cstivoautumnal* infections, however, forbid other than tentative diagnosis without the blood-findings. A careful anamnesis should be elicited, and the prevalence of the infection and its type, in the neighborhood in which the patient resides, or has lately been sojourning, is to be taken into account.

Multiple infections with the same variety of parasite and *mixed infections* (whether of different varieties of malarial organisms or of malaria and another malady—*e.g.*, typhoid fever) give such a varying clinical picture that an examination of the blood—or, on the other hand, bacteriologic or serologic study—is the only means of revealing the true type of infection.

When quinine has been taken before the patient comes under observation, the clinical manifestations may be so altered, both as to the periodicity and general type of the paroxysm, that one must again resort to the findings of the laboratory.

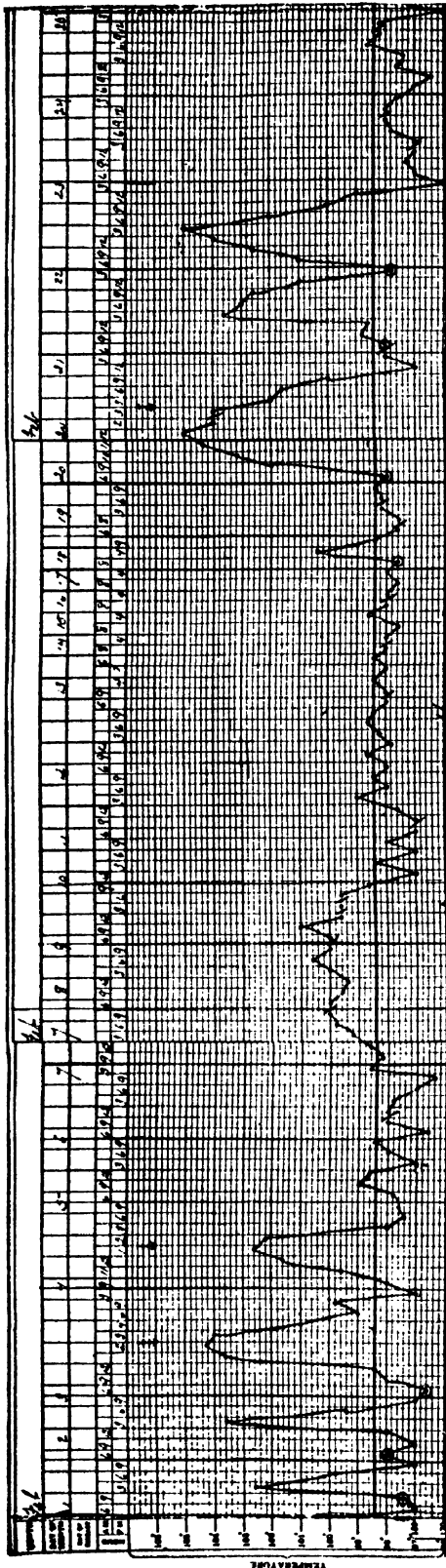


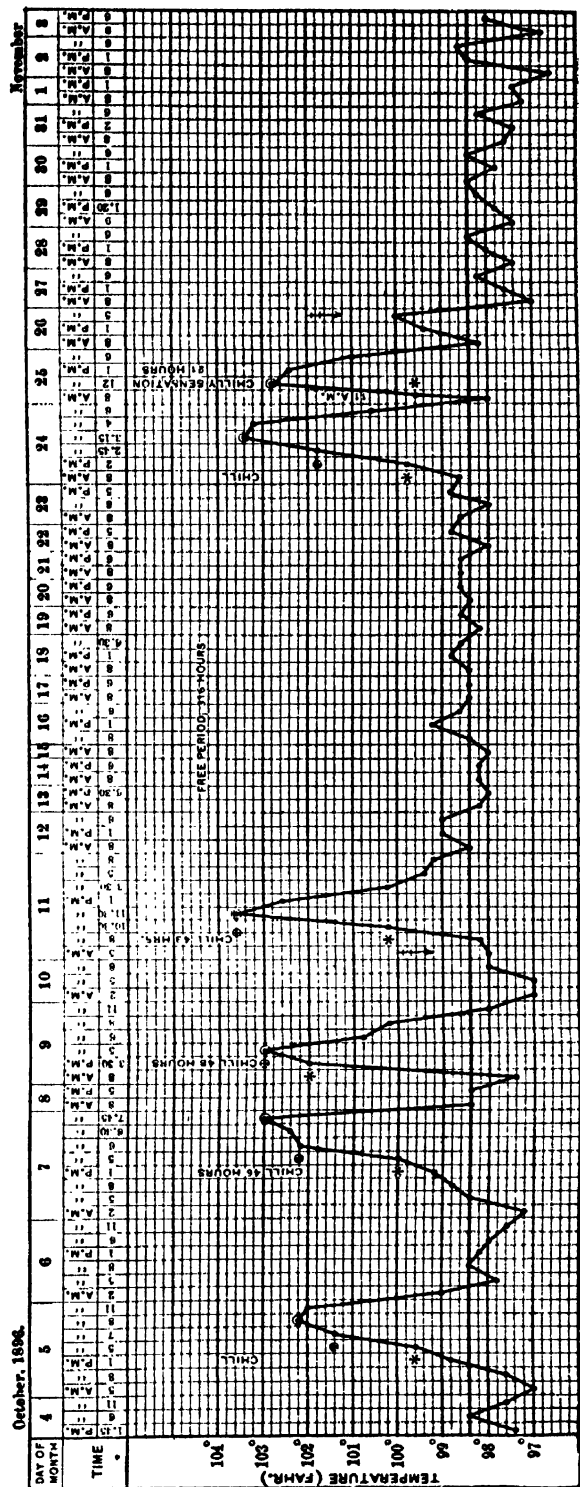
CHART I.—Temperature chart demonstrating double tertian malarial infection with freedom period of 329 hours after injection of quinine and urea hydrochloride. ⊙ Chill begins. † Injection given.

Differential Diagnosis.—Apart from the difficulties mentioned in the description of the pernicious forms of malaria, and in that of chronic, latent, and masked cases, there are three conditions concerning which the clinician must be constantly on guard—namely, the hectic fever of suppurations, malignant endocarditis, tuberculosis, septicemia, etc.; syphilitic fever, and typhoid fever. Every consultant has met with cases of all of these, erroneously called malaria. Sometimes there is mixed infection, which makes the diagnosis still more difficult.

Close resemblance between malaria and trench fever emphasized. But rigor is usual in malaria, provided the patient is not taking quinine. It occurs, but is unusual, in trench fever. Quinine controls the temperature in malaria in most cases, *i.e.*, it prevents more than one, or two further rises to 103° or 104° F. This, of course, applies to temperate climate malaria. Quinine has no effect in trench fever. Ward (Lancet, Apr. 12, 1919).

In typhoid fever, according to the observations of J. M. DaCosta and the senior writer, made nearly thirty years ago and since abundantly confirmed, it is common for a concurrent malarial infection to become abeyant, reappearing during the lysis or even after apparent recovery. Frequently, however, there will be a greater loss of hemoglobin than typhoid fever alone can account for, and leukemia, on the other hand, will be less marked. Malarial organisms will, as a rule, be absent from the peripheral blood during the height of the typhoid, but can in most cases be found toward its decline. The temperature curve may assume more of an intermittent or subcontinuous type than is common in typhoid, or

The misleading term *typho-malaria* and the cases of concurrent infection have already been dwelt upon. It is the irregular cases of estivoautumnal infection that give rise to the most confusion. A positive Widal reaction, a positive blood-culture, or a feces-culture yielding the *Bacillus typhosus* is, of course, demonstrative. In addition, the presence of motile bacilli in *freshly voided urine*, and a marked leucopenia without mononucleosis, are significant of typhoid infection. A negative Widal and



СИМВ. II.—Tertian intermittent. Free period 316 hours. (A. B. C.; Autumn, 1896.) * Beginning of chill. † Injection of 1 Gm. of quinine chlorhydrosulphate. ‡ End of chill.

blood-culture, absence of motile bacilli from the freshly voided urine, mononucleosis, absence of rose spots

after the ninth day, and especially the finding of free pigment in the blood, even without the finding of the parasites, points rather to malaria.

the only means of differentiation, nor is mixed infection impossible.

Dengue.—The cutaneous eruption and the severity of the muscular and bone pains, together with the blood-findings, are the principal points of discrimination.

Septic Fevers.—In all maladies accompanied by chills and fever, such as Charcot's fever, septicemia, pyemia, pyelitis, puerperal infections, malignant or infective endocarditis, or luetic infections, the history, the clinical aspect of the case, together with the symptoms and physical signs referable to each particular infection, and the all important blood-examination and cultures, will reveal the true nature of the existing illness.

Hepatic Abscess.—Although the liver is enlarged and tender, the spleen is most frequently non-palpable. Ordinarily, there is a history of dysentery, appendicitis, or gall-stones, as well as a freedom from malarial hemamebæ.

Insolation.—Especially in the tropics, care must be taken not to confuse malaria and sunstroke; and even in temperate climates the mistake is possible. The junior writer recalls a case studied by him while on ward duty in the Jefferson hospital. On a hot July day, in which cases of sunstroke had been brought in by ambulances and patrols in rapid succession, a man was admitted who had been taken from an electric tram car, in a severe chill. Temperature in the mouth was 104° F., but the body, bathed in a profuse sweat, was cold. Careful questioning elicited the history of a mild attack of malaria in New Jersey, the year previous; physical examination discovered a slightly enlarged spleen, and exam-

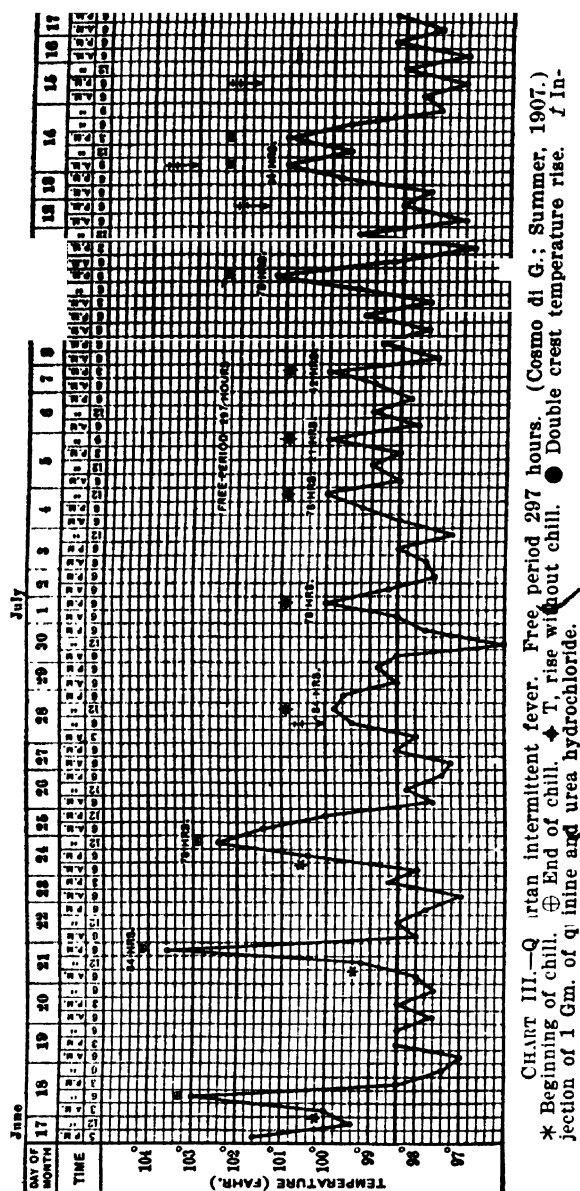


CHART III.—Q. Malarial fever. Free period 297 hours. (Cosmo di G.; Summer, 1907.)
* Beginning of chill. ⊕ End of chill. ♦ Rise without chill. ● Double crest temperature rise. † Injection of 1 Gm. of quinine and urea hydrochloride.

Other conditions may be considered briefly as follows:—

Yellow Fever.—Where the bilious, remittent, and hemorrhagic forms of pernicious malaria exist endemically in the same locality, a blood-examination revealing the plasmodia is often

ination of the blood demonstrated the tertian parasite.

Tuberculosis.—Tuberculosis may often be confounded with chronic malaria, or with a double quartan or tertian infection; and this is even more likely when the tuberculous process is aggravated by a coexisting streptococcic infection. The clinical or X-ray findings in the chest or abdomen, the absence of splenic tumor, the presence of tubercle bacilli in the sputum, feces, or urine, the absence of malarial parasites, and perhaps the cutaneous or constitutional reactions to tuberculin are the chief diagnostic facts.

Cholera and Dysentery.—Not only are there choleric form and dysenteric types of pernicious malaria, but the coexistence of the two infections—especially in the case of dysentery—is possible. Examination of the stools, and the finding of the characteristic ameba or bacillus, while examination of the blood for malarial organisms is negative, would be diagnostic.

A malarial seizure may be marked by sharp, localized abdominal signs and symptoms quite like those of appendicitis. The occasional occurrence of these abdominal manifestations in malaria is recognized in very few of the textbooks and monographs

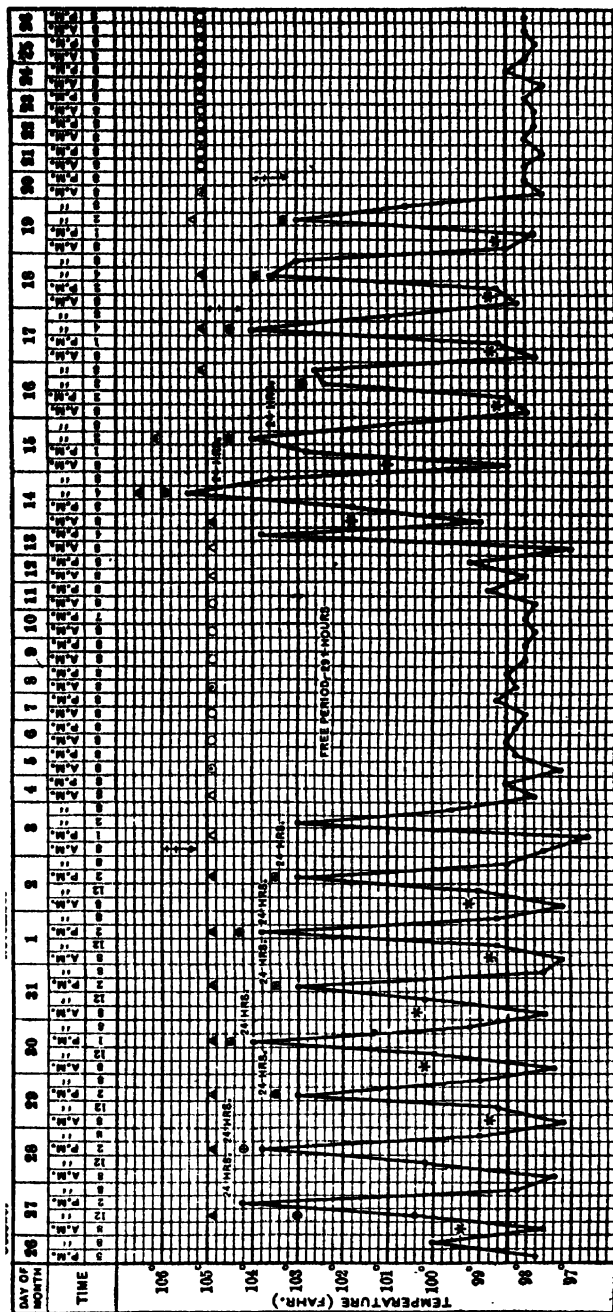


CHART IV.—Double tertian intermittent. Free period 291 hours. (Jos. D.; Autumn, 1892.) * Beginning of chill. ⊕ End of chill. † Injection of quinine and urea hydrochloride. Δ Organisms, pigmented, numerous. △ Organisms, hyaline, few. ○ No organisms.

dealing with the disease, and in the standard works on appendicitis the sections on differential diagnosis contain no reference to malaria. W. M. Brickner (Arch. of Diag., Apr., 1913).

While the toxemia of malaria produces many mental and nervous symptoms, these are not, in the modern sense, neurasthenic. The

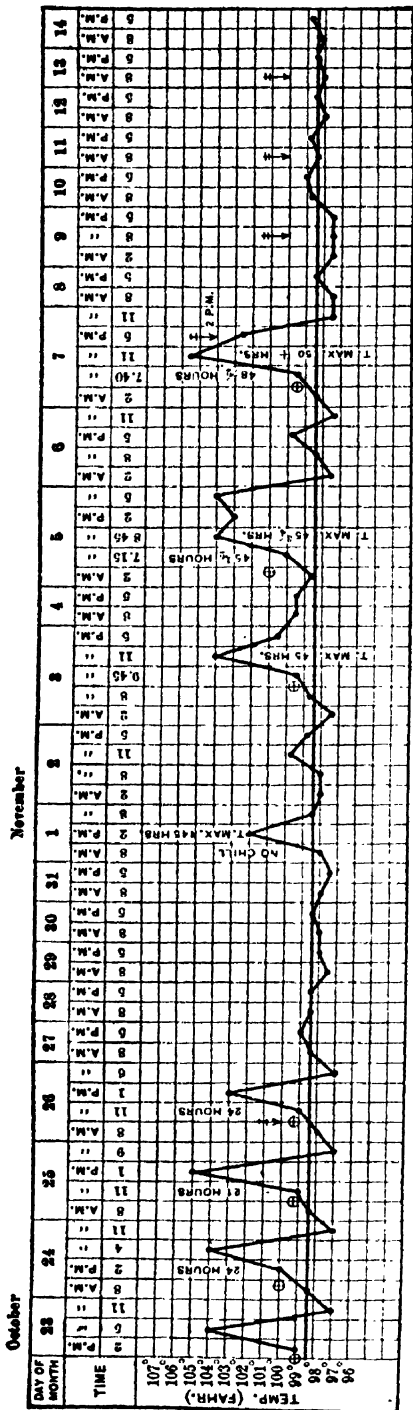


CHART V.—Double tertian intermittent fever. Free period 147 hours. Change of type to tertian. (Henry J.; Autumn, 1907.)
 ⊕ Beginning of chill. † Injection of 1 Gm. of quinine and urea hydrochloride.

points of differentiation are: Symptoms of true neurasthenia are, as a rule, worse in the morning, instead of in the afternoon; they are more of fatigue, irritative type, and intenser than those of chronic malarial ca-

chexia. Malarial cachexia is associated with prominent abdominal symptoms, such as a protuberant and distended abdomen, and enlarged spleen and liver, which are rarely present in true neurasthenia. Malarial poisoning is associated with a cachexial appearance, color, and reaction of the skin, with emaciation, all of which are absent in neurasthenia. Curran Pope (Boston Med. and Surg. Jour., Feb. 5, 1914).

PROGNOSIS.—This depends, of course, on the variety and virulence of the infection, the resistance of the patient, and the treatment instituted.

It is said, on good authority, that the ordinary *tertian* and *quartan* infections tend toward spontaneous recovery.

[The writer doubts whether this is common in tertian fevers in northern countries. Many years ago he shared a hospital service with a physician entertaining that view, and succeeded to a ward in which patients had shivered, and burned and sweated for several weeks,—in one case for two months,—to recover promptly under the use of quinine. This, of course, is a limited experience, but it indicates at least the probability that so-called spontaneous recovery is merely a suppression of paroxysms, the infection continuing in chronic or latent form. S. SOLIS-COHEN.]

Maltreatment, moreover, may result in a severe anemia,—a veritable dyscrasia,—draining the patient's vitality.

In the *cstivoautumnal* infections, if properly treated, the prognosis is good. When continuous cinchonization is neglected, repeated relapses may occur, and the disease becomes chronic, in which case the prognosis becomes highly unfavorable, if not grave.

The outlook in *pernicious cases* of all varieties is usually very grave, especially if more than one paroxysm occur. Heroic treatment does much to better the prognosis.

When malaria is *complicated* by other infections, the prognosis is not so good as in uncomplicated cases.

Repeated *relapses*, especially of estivoautumnal infections, and when prophylactic treatment is not followed, are highly dangerous.

Relapses are most troublesome and persistent among children, always active and impatient of control, and among adults whose duties force them out again too quickly after the subsidence of the fever. In these, relapses occur at short intervals, such as two or three weeks, up to from one to three months. The intervals bear some relation to the thoroughness of treatment. J. P. Bates (Jour. of Trop. Med. and Hyg., Aug. 15, 1913).

In *post-malarial anemias*, the prognosis depends upon the gravity of the anemia and its susceptibility to treatment. Except in those cases in which the blood impoverishment follows the pernicious infections, it is generally fair. In the latter type, death is often not far distant.

In *malarial cachexia*, a guarded prognosis should always be given, unless the patient is able to change his place of residence. In a suitable climate, under proper treatment, the prognosis is good.

PROPHYLAXIS.—The work of the United States Army Sanitation Corps in the Panama Canal Zone has demonstrated what can be accomplished. The methods necessary are thus stated: 1. **Measures** directed against the development of the plasmodia in man and in mosquitoes. 2. Measures aimed at the destruction of the malaria-transmitting mosquito. 3. **Prevention** of the access of the mosquito to man; both to man the infected, and man the infector. 4. **General education** of the public.

1. To destroy the source of infection in man (the gametes) quinine systematically employed is all-sufficient.

To prevent development of the sporozoites inoculated into man by

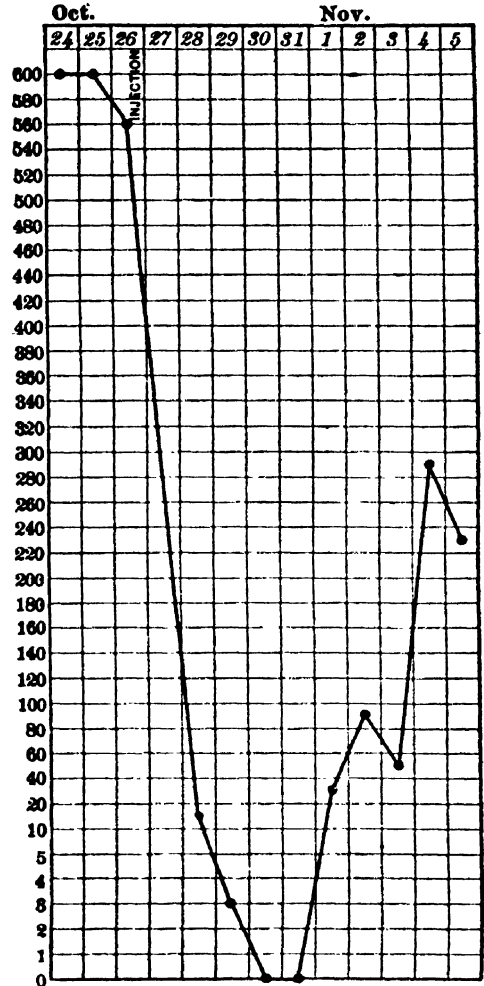


CHART VI.—Showing disappearance and reappearance of organisms after the injection of 1 Gm. of quinine and urea hydrochloride. (Case of H. J.)

the mosquito, the same method is effective.

From 5 to 10 grains (0.3 to 0.6 Gm.) of a readily soluble salt should be taken daily, preferably, in case of the larger quantity, in two doses, morning and noon. In certain regions, larger doses may be needed

occasionally. The bite of the infecting mosquito need have little terror when the blood constantly contains quinine.

The life cycle of the parasites is nearly always forty-eight hours, and eight or ten days must elapse after infection before they become sufficiently numerous in the blood to cause an attack of fever. It follows that if a full dose of quinine (10 or 15 grains—0.6 to 1.0 Gm.) be taken

of the malarial parasites in the blood. This can be effected by quinine, for the effective administration of which the author gives the following principles: 1. Quinine, administered daily, is in average and even therapeutic doses better tolerated, and for a longer time, than one would suppose. 2. Quinine taken daily is always present in the blood, and thus prevents, instead of producing, quinism. 3. If given at longer intervals than three days quinism presents itself every

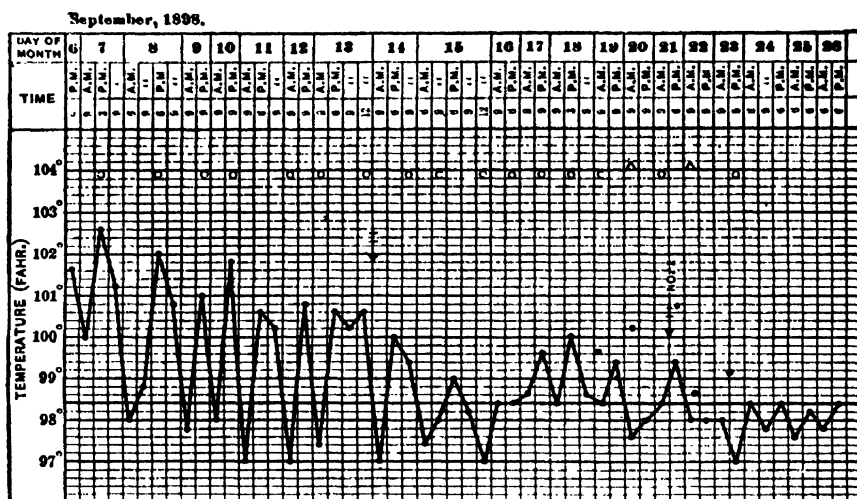


CHART VII (Illustrating diagnosis).—Mixed infection; typhoid and malaria. Widal reaction positive. Rose spots. (X. Y. Z.; from Tampa, Fla.) † Quinine and urea hydrochloride injected. ○ No organisms found. △ Organisms found.

on two successive days, with an interval of eight or nine days before the next 2 doses are taken, the parasites will always be destroyed before they can cause fever. Gray (Brit. Med. Jour., Nov. 11, 1905).

In Italy, from 1887 to 1895, over 15,000 people died annually from malaria. When the State administration of quinine was begun, the mortality fell year by year, until in 1906 it was only 4871.

The campaign which the State followed consisted: 1. In **destroying** or rendering inoffensive the **mosquitoes** *in externo*. This can be only partially effected, and is, moreover, costly, the means being **drainage, chemical, and screening** to keep mosquitoes away from persons. 2. In the destruction

time. 4. Few persons are intolerant of salts of quinine insoluble in water, if administered in average doses daily; and hemoglobinuria has never been encountered. 5. An insoluble salt, *e.g.*, quinine tannate, is slowly absorbed, is generally atoxic, and is particularly indicated for children. 6. Quinine in the basic state is absorbed and acts well. An essential of tolerance is administration in agreeable form, *e.g.*, comfits or chocolates. 7. He who takes quinine every day can expose himself without danger to bites by infected mosquitoes. 8. Arsenic and iron do not display any protective antimalarial action either experimentally or chemically demonstrable. Celli (Jour. of Trop. Med. and Hyg., Apr. 1, 1908).

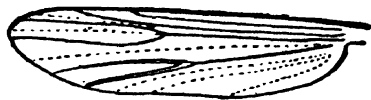
FIELD IDENTIFICATION OF MALARIA-CARRYING MOSQUITOES.

In a supplement (No. 32) to the U. S. Public Health Reports of October 19th, 1917, Surgeon Ernest E. Sweet publishes the following data for the field identification of the commoner *Anopheles* mosquitoes:—

For use in the field a small hand lens, magnifying from 2 to 4 diameters, is of service. Mosquitoes are distinguished from other similar appearing insects by the fringe of scales along the posterior border of their single pair of wings, the wing veins being also fringed with scales. If the insect in hand lacks the posterior fringe of scales it does not belong to the mosquito family, however much it may resemble that insect in appearance. There are three families of insects, the sand flies, the crane flies, and the midge flies, which may be confused with mosquitoes, but ordinarily the health officer will encounter little difficulty in making the differentiation even without examining the wing structure. The sand flies of the United States are much smaller in size than mosquitoes, while the crane flies are not only larger, but the body is long and slender and the length of the legs such as to be out of proportion even to that of the body. Midge flies, often called "midges," are usually seen in dancing clouds hovering over one's head in the late afternoon, and nearly all of those found in this country lack the long proboscis or biting part, have bare wings, and are more delicate than mosquitoes.



Wing of *Culex pungens*—Berkeley, 1902, Laboratory work with mosquitoes, p. 35, Fig. 27.



Wing of Diptera mistaken for mosquito—F. V. Theobald, Vol. 1, 1901, p. 92, Fig. 23.

Some species of *Anopheles* mosquitoes may fly a mile or more, but such long flights are unusual. Other varieties of mosquitoes are frequently carried several miles by the wind, but visitations of insects in this manner are not followed by outbreaks of malaria, as the insects are never *Anophelines*. The mosquito can not infect a person with malaria until at least eight days after it has bitten an individual with the malarial parasite in his blood, but once a mosquito is infected she probably remains so throughout life. Mosquitoes may live five or more months. The life cycle of the *Anopheles* mosquito includes four stages, the first three of which (egg, larva, and pupa) are invariably passed in water.

Determination of Sex.—Only the female bites, and for this reason it is essential that the sexes be differentiated. Fortunately this can be easily accomplished.



Head of *Anopheles*—male.

MALE.

Antennæ, of all varieties, markedly plumose, i.e., "heavily haired."



Head of *Anopheles*—female.

FEMALE.

Antennæ, of all varieties, not plumose, i.e., "sparsely haired."

Determination of Genus.—After determining that the insect in question is a mosquito and that the specimen is a female, the next step is to decide whether or not it is an *Anopheline*. In making this decision there are many facts to guide us, each of which must be considered in turn. For the purpose of comparison the most common variety of mosquito, the *Culex*, is selected and the differences throughout the various stages of development, beginning with the egg, noted.

Eggs.

ANOPHELES.

The eggs are laid singly, and for this reason are seldom found in nature. They float on the surface of the water and are supported by lateral air spaces.

CULEX.

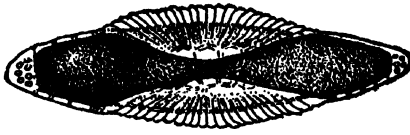
The eggs are laid in rafts or boatlike masses of about 200 and are readily visible to the naked eye. Instead of floating on the side they are arranged vertically. There are no lateral air spaces.



Ova—Anopheles.



Egg raft—Culex.



Egg—Anopheles maculipennis.

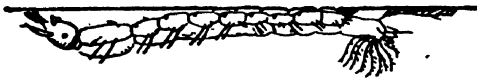


Egg—Culex.

Larvæ.

ANOPHELES.

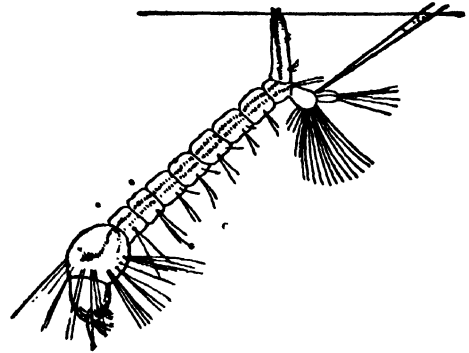
The larvæ lie at the top of the water and parallel to the surface, as Carter so aptly expresses it, "for all the world like a basking pike." The head is much smaller than the thorax. There is no respiratory siphon. Upon being frightened the larvæ may dive, but usually they dart parallel to the surface.



Larva of Anopheles.

CULEX.

The larvæ hang head downward from the surface of the water at an angle of about 60°. The head is much larger than the thorax. There is a long respiratory siphon at the tail. Upon being frightened the larvæ usually dart downward.

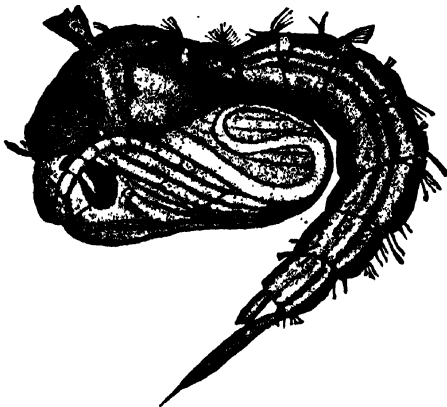


Larva of Culex.

Pupæ.

ANOPHELES.

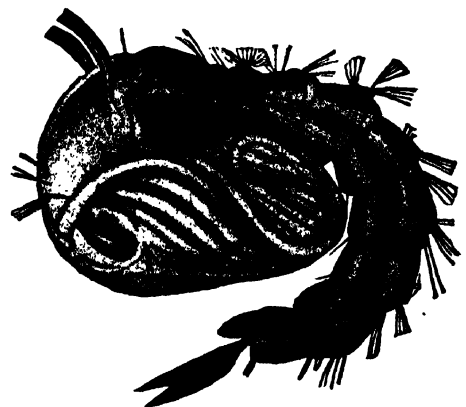
The pupæ are larger in the anteroposterior direction and narrow laterally. The respiratory siphons are short and trumpet like, the small end being attached near the middle of the thorax.



Anopheles punctipennis—Say, (Mosquitoes of N. America, Vol. 2, 1912, Howard, Dyar, and Knob plates.)

CULEX.

The pupæ are shorter and broader from side to side. The respiratory siphons are long, narrow, and tube like and are attached near the posterior end of the thorax.



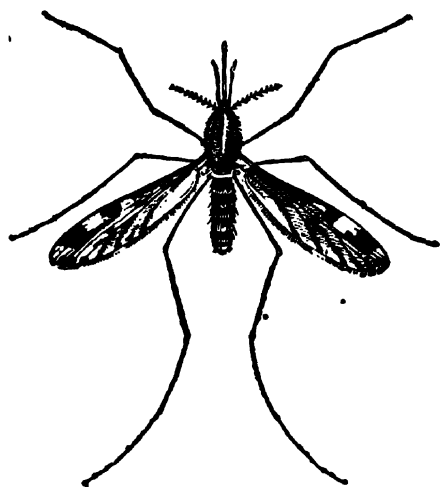
Culex pipiens—Linnæus. (Mosquitoes of N. America, Vol. 2, 1912, Howard, Dyar, and Knob plates.)

It should be borne in mind in searching for larvæ that they are remarkably shy, and for this reason it may be necessary for the examiner to wait over the pool for some little time in order that they may come to the surface after their disappearance. Should the observer encounter difficulty in determining the genus of the aquatic forms he should remove the larger larvæ or pupæ from the pool and allow them to hatch under artificial conditions, in this way obtaining the adult insect for additional guidance. While the larval characteristics are thoroughly dependable in the determination of the *Anopheles* genus, the health officer will naturally be called upon more often to make the identification from the adult specimen; for this reason familiarity with the appearance of the fully developed insect is all important. Adult Anophelines are distinguished by the following characteristics:

Adults.

ANOPHELES.

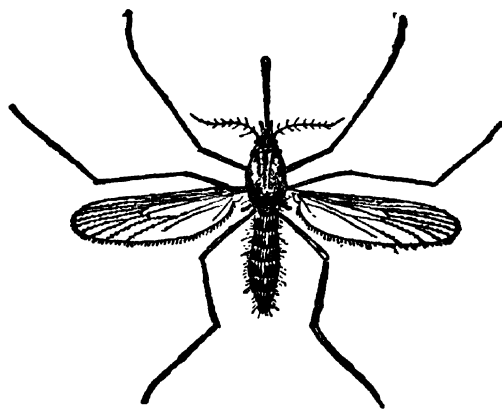
The wings are distinctly spotted. In the female the palpi are about the same length as the proboscis. This is true in no other mosquito except one, which happens to have a curved proboscis. Therefore, if the specimen is a female and if the palpi are nearly as long as the straight proboscis the insect is an *Anopheles*.



Anopheles punctipennis, female.

CULEX.

The wings are not spotted. In the female the palpi are much shorter than the proboscis.



Culex pipiens, female.

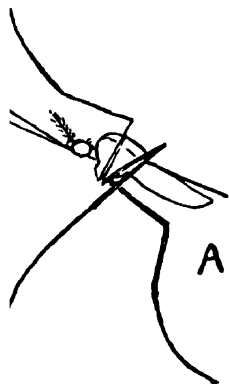
When resting or biting the proboscis, head, thorax, and abdomen form one straight line.

When resting or biting the insect is "humpbacked"; head and abdomen are down, thorax is up.

Habits.

ANOPHELES.

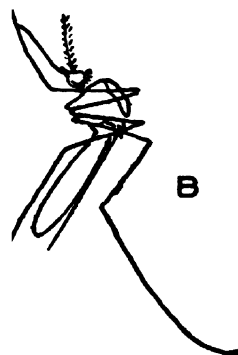
The *Anopheles* mosquito is far less annoying than the *Culex*. It seldom bites in the daytime and does not often attack a person moving about. The bite is also less painful. The hum of the insect is not as distinct as that of the *Culex*. Anophelines prefer to breed in cleaner water than do the Culicines.



Resting position—*Anopheles*.

CULEX.

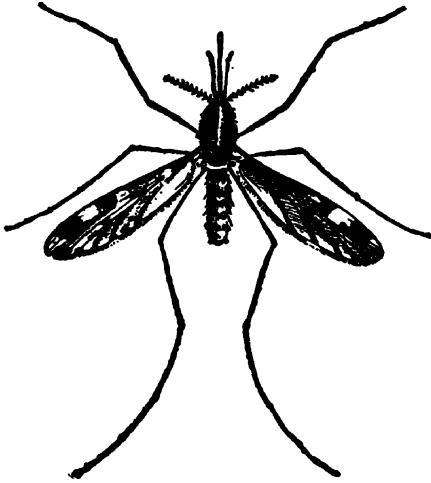
The *Culex* mosquito is distinctly annoying. It bites at all times and is not shy, as is the *Anopheles*. The bite is irritating. The hum is particularly loud. Culicines are less particular concerning the character of the water in which they breed than are the Anophelines.



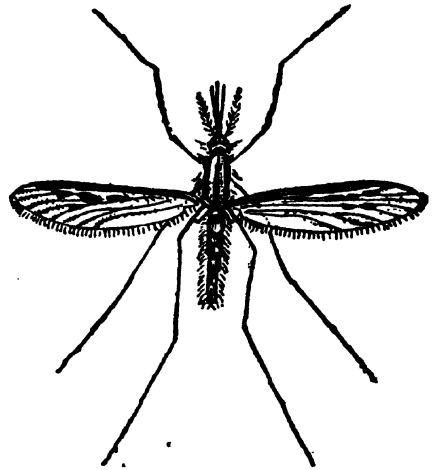
Resting position—*Culex*.

Three Anophelines occur commonly in the United States. All have been proven to be transmitters of malaria. They may be distinguished by their wing markings as follows:

Anopheles Punctipennis.—A large square or oblong white or yellowish patch at the anterior margin of the wings near the outer end is the striking characteristic. This patch of white is readily visible to the naked eye and is easily seen even when the insect is in the resting position with the wings crossed. After determining that the insect is a female *Anopheles* this patch of white should be looked for; if not found the specimen is sure not to be a *punctipennis*. The anterior margin of the wing is dark, while the balance is lightly spotted or mottled with black, with an almost invisible white spot at the extreme apex. Besides breeding in quiet waters *A. punctipennis* is the only one of the three Anophelines which breeds in running water and streams which are subject to freshet from rains. This particular insect is more often found on porches, in outbuildings, and under houses than within habitations.



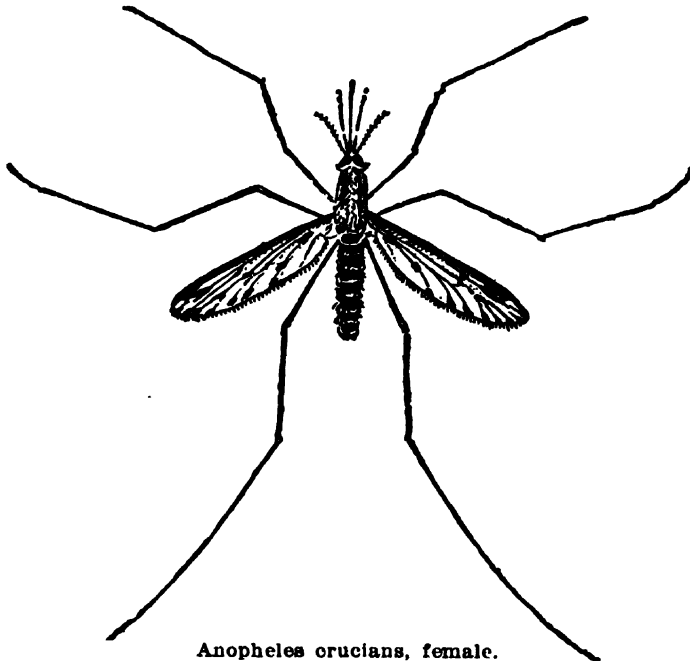
Anopheles punctipennis, female.



Anopheles quadrimaculatus, female.

Anopheles Quadrimaculatus (maculipennis).—Three to five, but usually four, black spots (patches of black scales) on the second and fourth wing veins. Breeds more often in quiet waters, pools, etc., and invades human habitations.

Anopheles Crucians.—The wing is dusky and the veins are prominently marked. The characteristic marks are three small spots of black on the sixth wing vein (thoracic end, posterior margin). In the young insect the spots are apt to be distinct, but if the specimen is old the end spot is usually missing.



Anopheles crucians, female.

Malaria is perpetuated by patients carrying the plasmodium through the winter and infecting anopheles mosquitoes in the spring. Uncured malaria is therefore a menace to the community. The use of **quinine** should be continued until after the mosquitoes have been destroyed by the cold, while prophylactic doses should be taken the following spring. S. Harris (Trans. Amer. Med. Assoc.; June 7, 1910).

As a factor in malaria control, malaria in infected persons may be eradicated either by destroying the mosquitoes or by destroying the infection in man. We could eliminate malaria from a region by disinfecting all infected persons in the region, regardless of the abundance of mosquitoes, if all infected persons were cured. There would then be no malaria for mosquitoes to transmit. As it is, however, physicians relieve their patients of active clinical symptoms, but few actually disinfect their patients. In the experiments in Mississippi, the data obtained indicate that between 50.77 and 68.86 per cent. of all persons who have attacks of malaria during a given year have relapses and not new infections. The standard, practical method of treating and disinfecting persons who have malaria, adopted in the Mississippi experiments, is: Under 1 year of age, $\frac{1}{2}$ grain (0.03 Gm.) of **quinine**; 1 year, 1 grain (0.065 Gm.); 2 years, 2 grains (0.13 Gm.); 3 and 4 years, 3 grains (0.2 Gm.); 5, 6 and 7 years, 4 grains (0.26 Gm.); 8, 9 and 10 years, 6 grains (0.4 Gm.); 11, 12, 13 and 14 years, 8 grains (0.5 Gm.); 15 years and older, 10 grains (0.65 Gm.); to be taken every night. This treatment appears to disinfect more than 90 per cent. of patients. Bass Amer. Public Health Assoc.; Jour. Amer. Med. Assoc., Nov. 22, 1919).

2. To destroy the mosquito and prevent breeding, it is necessary to institute thorough and free **drainage of marshy lands**, swamps, and known breeding places. **Kerosene oil** spread

over the surface of the water will destroy the larvæ. A mixture containing **crude carbolic acid** is also employed. **Aniline dyes**, as advocated by Celli, deserve further investigation and trial. **Pyrethrum powder** may be burned on porches, in chambers, and other places frequented by the insects. Other methods can be found in special works upon this subject.

The writer applies the principle of **sticky fly paper** to the destruction of malaria-bearing mosquitoes. A kind of screen or trellis work, about 6 feet by 4.5 feet, is smeared thick with heavy crude oil, which is sticky enough to catch and hold mosquitoes. They can be attracted to the screens by hanging a small lantern in the center. Bosurgi (Gaz. degli Osped., vol. xxviii, Nos. 21-27, 1907).

Mosquitoes will not bite where the skin is smeared with **petrolatum**. The writer smears all the exposed skin with petrolatum once every day or two, and found that this permits tranquil sleep amid myriads of mosquitoes. Albano (Policlinico, Sept. 1, 1918).

3. Exclusion of the mosquito requires effective **screening** of all dwellings, and mosquito **canopies** over the bed. One should **sleep** at a sufficient height **above the ground**, and **dwellings** should be located as far as possible from **marshes** and **mosquito-harboring vegetation**.

In the writer's district the proportion of persons primarily affected has dropped from 38.71 per cent. to 0.3 per cent. since the houses have been screened, in one of the greatest hotbeds of malaria. In the regions where malaria is not bad, prophylactic doses of **quinine** are sufficient to ward off infection, but in the worst infected districts mechanical measures are indispensable. Casardi (Gaz. degli Ospedali, vol. xxvi, No. 112, 1905).

The antimalarial methods used on the Isthmus of Panama consist (in the order of their importance) in: 1. **Destroying** the habitat of the anopheles during the larval stage within a hundred yards of dwellings. 2. **Destroying** within the same area all protection for the adult mosquito. 3. **Screening** all habitations so that the mosquito can not have access. 4. Where breeding places can not be done away with by draining, use is made of **crude oil** and **sulphate of copper** for the destruction of larvæ. Gorgas (Military Surgeon, Apr., 1909).

To prevent mosquitoes from biting, the writer found a **phenol lotion**, 1:60 or 1:40, and also **eucalyptol**, f3j (4 c.c.), in glycerin or olive oil, f3ij (60 c.c.), useful for local application. G. A. Wolfendale (Jour. of Trop. Med. and Hyg., May 2, 1910).

Mosquitoes will enter a house in search of blood (only the female mosquito bites, not the male), as this food stimulates and accelerates ovulation, that is, the laying of eggs. They usually find entrance through defective screens, such as those of 12 or 14 mesh wire; corroded or torn wire screens; the sides of poorly-fitting screen doors, and window screens. They also enter through chimneys, drain holes, etc. Anopheles mosquitoes, in particular, have the faculty of searching for and finding such defects. These mosquitoes usually take their flight at night—that is, as soon as dusk or twilight comes on—so that it is generally reckoned that their flight is during the hours between sunset and sunrise. They are attracted to houses by light. They are not content on finding that the entrance to a house is closed to them by screens, but seek to find any opening by which they can enter. It is therefore important that every accessible opening into a house which might permit the entrance of mosquitoes be carefully closed.

It is very generally accepted that the anopheles mosquitoes do not fly

high, and therefore do not enter rooms on the second or third floors of a house; but it has also been found that these mosquitoes will fly over the tops of houses and, when attracted by the reflected light from chimneys, will enter by that route through the fireplaces into the house. R. H. von Ezdorf (U. S. Public Health Service Reports, Feb. 27, 1914).

4. Campaigns of **public education** have been carried on, and should be further encouraged. Much can be done in this manner by driving home to the public the tremendous economic loss due to malaria.

Isolation of malarial sufferers is recommended in camps and similar places. But social and economic problems so far have interfered with the carrying out of this plan.

The writer, among inhabitants of endemic foci of malaria, found the plasmodia in the blood of 53 out of 146 persons free from the slightest indication of malarial disease. This large percentage of healthy carriers is extremely important from the standpoint of general prophylaxis. When no parasites were found in the peripheral blood, he gave a single therapeutic dose of **strychnine**, and found that in from thirty to sixty minutes the parasites ensconced in internal organs were driven out by the action of the drug and could then be discovered in the peripheral blood. Not until the findings were constantly negative after this test was the individual regarded as free from the germs. Ianni (Jour. Amer. Med. Assoc., from Policlinic, Dec. 4, 1910).

TREATMENT.—In every case in which acute malaria is suspected, the patient should be put to **bed** and carefully observed. The **nursing** and **diet** should be such as are appropriate in fevers in general, until typhoid, at least, can be excluded, when the diet may be made more

liberal. **Calomel**, followed by a mild **saline aperient**, should be administered; and after the resultant evacuation, the **bowel** should be irrigated with a warm saline solution. **Disinfectant measures** appropriate to typhoid should be instituted and kept up until proved to be needless.

The medicinal treatment of acute malaria may be summed up in a word—**cinchona**. The bark and its derivatives should be, if possible, used in every case, both as a curative agent and as a means of prophylaxis.

A hypodermic injection of **morphine sulphate**, $\frac{1}{4}$ grain (0.016 Gm.), and **atropine sulphate**, $\frac{1}{150}$ grain (0.0004 Gm.), will markedly modify the severity of the chill if administered before it is due. Paine (St. Louis Med. Rev., Nov. 1907).

There are a few instances in which the cinchona group of remedies cannot be employed in effective dosage on account of the hypersensibility (so-called idiosyncrasy) of the individual patient; and there are some instances in which these drugs are ineffective for reasons not apparent. But both classes of exceptions are numerically insignificant in comparison with the thousands of cases in which the rule applies. They will be discussed later.

The war brought out a number of new agents and revamped older methods of treatment, none, however, even approximated in value the preparations of cinchona. Disodo-luargol, arsenic, strychnine and tartar emetic may be mentioned as examples of the series. The last named alone warrants further trial. EDITORS.

The writer obtained disappearance of malignant tertian crescents—which are uninfluenced by quinine—in 4 patients, by intravenous injection of **tartar emetic**. L. Rogers (Brit. Med. Jour., Jan. 6, 1917).

The writers describe 3 cases treated with tartar emetic in 2 per cent. solution intravenously, each dose of the drug amounting to 2.4 grains (0.16 Gm.). Even these comparatively large doses had no ill effects on the circulation. In the tertian form of malaria the treatment is inferior to the use of quinine. A lowering of temperature occurs and the patient is made to feel better, but the plasmodia are not banished from the bloodstream. Levy and Wall (Interst. Med. Jour., Sept., 1917).

In 8 cases treated intravenously with tartar emetic, the writers included infections both with benign and malignant tertian parasites. The drug was used in a 2 per cent. solution, to which 0.5 per cent. phenol was added to preserve its sterility. Of the two mixed infections, the crescents disappeared in both cases, the benign tertian parasites persisting in one and disappearing in the other. In the subtertian crescent infections the crescents disappeared after three injections of tartar emetic. In spite of the disappearance of the crescents the patient had three typical clinical attacks of malaria. Falconer and Anderson (Lancet, Nov. 17, 1917).

A trial of tartar emetic at an Indian hospital in German East Africa showed that in the subtertian type curative effects occur in varying degrees only when doses toxic to the patient are given. T. A. Hughes (Indian Med. Gaz., Feb., 1918).

We have now to consider in relation to the great bulk of cases—*i.e.*, those in which cinchona is tolerated and is efficacious: 1. The effect of the drug. 2. The choice of preparation. 3. The manner of administration. 4. The time and frequency of administration. 5. The dose. 6. Possible contraindications.

Action of Cinchona.—Cinchona contains a number of alkaloids of which quinine is the most potent and this, in the form of one of its salts, is the anti-

malarial specific *par excellence*. Notwithstanding its large use and careful study, its mode of action upon the infecting organism and upon the blood has not been so clearly demonstrated as to escape question.

Certain observers hold that the blood plasma and the phagocytes are the actual efficient agents in the destruction of the malarial organisms. They point to the fact that it is the free spores (merozoites) and the young organism rather than the adult hema-mebas which apparently yield to the drug, and credit quinine only with a hemolytic effect upon the infected corpuscles, which permits the plasma to reach the merozoites at their least resistant period. From the clinical side they cite the inability of quinine given before an attack to abort the paroxysm and the relative meagerness of organisms after a hemolytic crisis, as in black-water fever. From the experimental side they bring forward observations such as those of Bass, who has cultivated the plasmodia *in vitro*, studying carefully the effect of serum alone, and of quinine and other substances under conditions which permitted or excluded the serum action.

Nevertheless, the great outstanding fact remains that it is just quinine (or some recognized parasiticide, such as salvarsan) that cures malaria. (The writers are skeptical of so-called spontaneous recovery.) The blood plasma and the phagocytes alone do not prevent original infection; they do not even prevent the few spores that ordinarily survive quinine, from developing, multiplying, and producing relapse—perhaps through Craig's intracorpuseular conjugation—in cases inadequately treated; they do not prevent or overcome latent, chronic, or masked

infection. On the other hand, quinine, if supplied to the blood continuously and sufficiently, enables one to resist inoculation by infected mosquitoes; prevents relapse; and if administered at the proper time, and in the right way, will prevent an expected paroxysm from manifesting itself. There seems to be little ground, therefore,—while admitting the value of serum and phagocyte,—for questioning the actual parasitocidal effect of the drug.

In the case of the ordinary *tertian* organism (*Haemaphysa vivax*) quinine is toxic to all stages of the developing parasite, until the beginning of sporulation, causing fragmentation and degeneration. It is particularly fatal to the young plasmodia and to the spores when set free. Schso has shown that it will inhibit the development of gametes within the mosquito.

According to Craig, quinine is likewise toxic to all stages of the *quartan* parasite (*Haemaphysa malariae*) although the latter is more resistant than the *H. vivax*. Antolisei and Golgi, however, found quinine without effect upon the adult quartan parasite. The senior writer's limited (clinical) observations accord rather with those of Craig. Data are wanting to determine the effect of quinine upon quartan gametes.

Marchiafava and Bignami have carefully studied the effect of quinine upon *estivoautumnal* parasites. They found that in fresh specimens the young plasmodia became discoid and were extruded from the erythrocyte, while their mobility remained normal or was increased. Craig, however, was not able to observe this extrusion, although he saw change of form and position. The drug has little effect on the larger pigmented forms, the only change de-

monstrable being an increase in the refractive index. Degeneration by fragmentation has not been observed in unstained specimens.

These pigmented forms can continue their development with slight morphologic changes for as long as three days after quinine has been administered, but ultimately succumb to degeneration, such as has been described in the ordinary tertian parasite. The

vented by the timely and persistent use of quinine.

Bass contends that quinine has no direct destructive effect upon malarial organisms, its virtue depending upon the fact that it renders the red blood-cell protecting the parasite more permeable to the all-sufficient serum. Hence the drug can bring about the destruction of those parasites that are in the circulating blood, but not of those

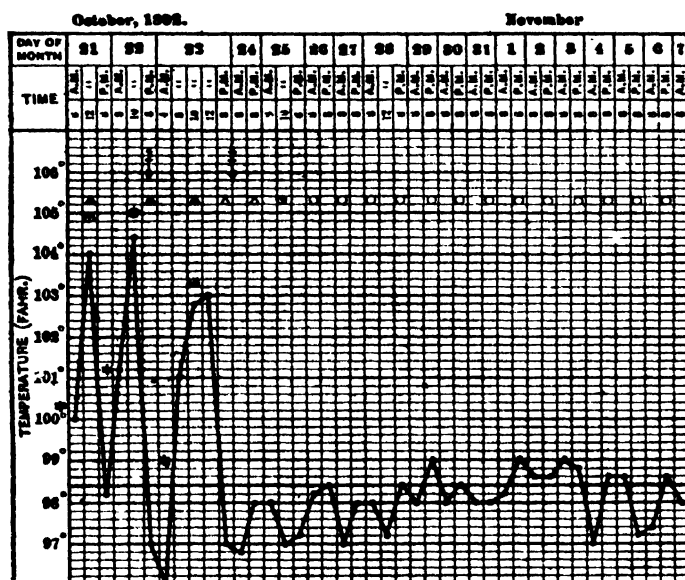


CHART VIII.—Double tertian intermittent of 30 days' duration prior to treatment. Two injections. Recovery. (John S.; Autumn, 1892.) * Beginning of chill. ⊕ End of chill. † Injection of 1 Gm. of quinine and urea hydrochloride. Δ Organisms, pigmented, numerous. △ Organisms, pigmented, few. ⊙ Organisms, hyaline, few. ○ No organisms.

ring forms show slight degenerative changes, especially loss of nuclear chromatin. The young pigmented forms quickly undergo fragmentation. The gametes (crescents) are highly resistant and quinine does not appear to hinder their capacity to develop within the mosquito. Their appearance, however, may be prevented if quinine be administered promptly and adequately at the beginning of an infection.

Intracorpuseular conjugation, which tends to keep infection alive and bring about relapses, is absolutely pre-

contained in corpuscles that have become lodged in the deeper capillaries, which are not reached by it until they segment. His experiments *in vitro* show, moreover, that blood from individuals fasting and at rest is more destructive to the organisms than that taken during exertion or after a meal; but that this superiority of fasting blood can be overcome, and the cultures protected, by the addition of a certain quantity of dextrose. Hence it would appear that the empirical rule of administering quinine "upon an empty

stomach" is well founded, and that it might be well to go still further and prolong the **fast** until after the time of paroxysm. The importance of **rest** is also emphasized by these studies.

Choice of Preparation.—Since **cinchona** alkaloids have been available, the bark and its galenical preparations have fallen into disuse for the treatment of active malaria, but they may be used in after treatment, especially in the form of the compound (Huxham's) tincture, for the sake of the tonic effect of the pleasant bitter upon the digestion and appetite.

In ordinary tertian infections it is of little moment—now that there is no tariff upon the **quinine salts**—which one is used; but in estivo-autumnal infections, and especially in the pernicious varieties, and also in highly malarious regions, promptitude of action and potency of effect are important, and small differences become great. In the senior writer's experience the very soluble double salt, somewhat loosely termed **quinine and urea hydrochloride** has proved the most efficacious. This may be owing in part to a superior cytolytic power.

As little as 0.5 Gm. ($7\frac{1}{2}$ grains) of **quinine hydrochloride**, given with 0.05 to 0.1 Gm. ($\frac{3}{4}$ to $1\frac{1}{2}$ grains) of **arrhenal**, will cure the most rebellious forms. The 2 drugs should enter the blood together in 6 or 7 doses before a paroxysm. The arsenical reinforces quinine and probably activates phagocytosis. A. Gautier (Bull. de l'Acad. de méd., Apr. 24, 1917).

In general, the question is one of (1) the solubility, and (2) the alkaloidal richness, of the particular salt. The following table will prove useful to show these points:—

Salt.	Percentage of alkaloid in salt.	Solubility in cold water. (Expressed in parts by weight of solvent to 1 part of drug.)
Sulphate	73.5	800
Bisulphate ..	59.1	11
Hydrochloride	81.8	40
Dihydrochloride	72.0	0.96
Carbamide-hydrochloride.	58.0	1
Hydrobromide	76.6	45
Dihydrobromide	60.0	7
Phosphate	76.2	420
Valerianate	73.0	120
Lactate	78.2	10
Salicylate	70.1	225
Arsenate	69.4	Very slight.
Tannate	20.0	Very slight.

Methods of Administration.—Quinine can be given by the mouth or the rectum, or may be injected into the veins, into the muscles, or under the skin. The writers prefer the hypodermic or intramuscular method, when the injections are made by one who is familiar with the technique that safeguards the patient from sloughing or abscess. In hospitals, as a rule, this should be the duty of internes, not leaving it to nurses, save in the exceptional instance.

Quinine salts can be administered efficaciously *by the mouth*, but should always be given in such form that the drug can be absorbed readily from the stomach. Solution, wafer, or dry capsule may be given, according to convenience and eligibility in the individual case. Pills and tablets are to be avoided. The drug is most effective when taken into a fasting stomach, and after free purgation—hence meal-times and stools should be adjusted to the necessities of the case. *Rectal administration* is not a method of choice, but may be employed when absolutely necessary. Large doses are requisite, at least double the quantity that would be given *per os*.

Solution or suppository can be used, preferably the latter. Absorption is slow in any event, and solutions sometimes irritate. The anesthetic effect of the combination with urea is here, at times, of service.

For *hypodermic* and *intramuscular injections* the preferable salts are the *dihydrochloride*, *chlorhydrosulphate*, and the *carbamide hydrochloride* (quinine and urea) combination; although the hydrochloride, the bisulphate, the acid hydrobromide and even, in emergency, the sulphate have been employed.

The technique of the senior writer is absolutely necessary with the carbamide hydrochloride combination (quinine and urea hydrochloride) and may be of benefit with the other salts. The skin at the site of injection is to be cleansed thoroughly (*e.g.*, with green soap and alcohol) and painted, for an area of about 1 inch in diameter, with tincture of iodine or iodine-acetone. The syringe and needle should be surgically sterilized; and, preferably, an all-glass high power syringe used. The needle is to be plunged deeply beneath the iodized skin, and best, into the muscle. It should be emptied completely before withdrawal, to avoid dripping upon the skin. As a further precaution, a piece of thin rubber protective may be stretched over the skin and the needle passed through it to make the injection—but this is not essential. The point of puncture should be sealed with collodion or iodoform-collodion. The *solution* to be injected should be made extemporaneously with boiling water. A convenient custom is to have a supply of papers or capsules, each containing the weighed quantity for

a single dose (usually 1 Gm.—15.5 grains) in the ward, and it is then a simple and quick matter to fill the syringe with the hot water and dissolve the drug in this quantity—ordinarily 2 or 3 c.c. A gram (15.5 grains) of quinine dihydrochloride, or of quinine and urea hydrochloride, will dissolve, however, in 1 c.c. of water.

The best salt for hypodermic use, in the author's opinion, is the acid hydrochloride, which dissolves in less than its own weight of water. The author makes up a solution as follows:—

R Quinine dihydro-
chloride gr. lxxv (5 Gm.).
Distilled water .. f3iiss (10 c.c.).

Use 15 minims (1 c.c.) as a dose, which will contain $7\frac{1}{2}$ grains (0.5 Gm.) of quinine.

The amount needed in the twenty-four hours is about 24 grains (1.5 Gm.), given in divided doses. In severe, but less urgent forms, if given by the mouth, the amount should run up to 30 or 40 grains (2 or 2.6 Gm.) a day. In most urgent cases, it may be deemed advisable to give the drug intravenously. F. S. Meara (*Interstate Med. Jour.*, Apr., 1911).

The superiority of **quinine and urea hydrochloride** for injections lies in its high solubility. It will dissolve in its own weight of water, especially hot water, and an ordinary syringe-ful may thus contain from 15 to 18 grains (1 to 1.2 Gm.) if necessary. The preferable solution is 50 per cent., and the ordinary dose is 1 Gm. (15 grains) in 2 c.c. ($\frac{1}{2}$ fluidram) of water. In malaria of the types ordinarily seen in northern latitudes, a single injection of this strength will cause suspension of the paroxysms for from a week to a fortnight (six and one-half to thirteen and one-half days). One injection daily or on alternate days for a week ordinarily suffices to bring about complete recovery. After this, to make sure

against chronic infection or sequels, the drug should be continued in doses of 10 grains (0.6 Gm.) in capsule by the mouth, daily, for another week; and then administered once a week, in the same way, for two or three months. S. Solis-Cohen (Med. Times, Mar., 1912).

A large part of the malaria prevalent in the Panama Canal Zone is due to the occurrence of relapses, and not to reinfections. This is apparently due to the presence, particularly in the bone-marrow, of asexual parasitic forms, which when conditions are favorable increase and give rise anew to manifestations of the disease. The following plan of treatment has practically rid Americans of the disease:—

(1) **Calomel**, 3 to 5 grains (0.2 to 0.3 Gm.), followed in twelve hours by 2 fluidounces (60 c.c.) of 50 per cent. **magnesium sulphate** solution. (2) **Quinine sulphate**, 20 grains (1.25 Gm.) in 4 fluidrams (16 c.c.) of distilled water with 4 drops of concentrated **hydrochloric acid**. (3) **Quinine sulphate**, 15 grains (1 Gm.), prepared as before, three times daily for a week, after which dose reduced to 30 grains (2 Gm.) daily for ten days. (4) When vomiting is present, **quinine bihydrochloride**, 22½ grains (1.5 Gm.), given in 5 fluidrams (20 c.c.) of normal **salt solution** as deep subcutaneous injection. (5) In obstinate relapsing cases, **quinine injections** of 15 to 30 grains (1 to 2 Gm.) in 300 to 500 c.c. (10 to 16 fluidounces) of normal saline, given **intravenously** on two succeeding days, then 45 grains (3 Gm.) a day by mouth. (6) **Arsenic, iron, and strychnine** as tonics. James (Jour. of Infect. Dis., May, 1913).

The hypodermic route of administration of the **quinine** is to be preferred in children to all others, as it is more prompt in action, more sure in results, and really easier on the child than either by the mouth or inunction. The drug is administered in 2 doses. The measure is comparatively painless and allows the child

more rest, besides being much less trouble to the attendants. B. H. Booth (N. Y. Med. Jour., Jan. 10, 1914).

Intravenous injection is urged by many authors, especially Baccelli, Marchiafava, and Bignami, for selected cases, and whenever there is urgency, as in the comatose, algid, and other pernicious forms of malaria.

Baccelli's solution has about the following formula:—

R *Quinine dihydrochloride* gr. xv (1 Gm.).
Sodium chloride .. gr. iss (0.075 Gm.)
Distilled water ... f3iiss or f3iij (10 c.c.).

It is practically a 10 per cent. solution of quinine dihydrochloride in physiological salt solution.

Under aseptic precautions, this method has, according to Baccelli, reduced the mortality of pernicious forms of malaria to 6 per cent.

Time and Frequency of Administration.—In cases of pernicious type, or of great severity, quinine should be given intravenously, intramuscularly, or hypodermically as soon as the diagnosis is made—in urgent cases, even before the microscopic study of the blood, since this may be completed while the drug is at work, and in any event no harm will be done. An unnecessary dose of quinine will not kill—pernicious malaria may. Repetition of the dose should also be more frequent than in ordinary cases—every two to eight hours, according to effect. Ordinarily, however, it is safe to wait and establish by clinical observation and microscopic blood studies the species of the infecting organism and the type of the paroxysms. Since quinine action is at its height about one

to two hours after intravenous injection, three to four hours after intramuscular or subcutaneous injection, and six to eight hours after ingestion, the drug should be administered accordingly—so that its period of maximum effect may coincide with, or slightly anticipate, the period of complete segmentation of the parasite—the aim being to kill the spores and young organisms and thus prevent them from reaching maturity to provoke further paroxysms and to bring about further intoxication and cell destruction. Thus, if the next paroxysm is expected at, say 4 o'clock P.M., the intravenous injection should be made one hour earlier (*i.e.*, at 3 P.M.) or the intramuscular injection four hours earlier (*i.e.*, at noon), the entire daily dose (about 1 Gm.—15.5 grains) being given. If the drug is to be taken by the mouth, the daily dose (about 1.5 Gm.—24 grains) is best divided into two portions, of which one—in the case supposed—would be administered at 12 M. and one at 8 A.M. (four hours and eight hours, respectively, before the expected chill). If the paroxysms tend to recur daily, the drug should be given daily in the same way (adjusted, however, to the so-called *anticipating* chill time—*i.e.*, one hour earlier each day) or to the actual variation of period established by observation, which may be, as in cases observed by the writers, twenty-one and twenty-four hours alternately, or some other figure. When the paroxysms are *tertian*, only a half-dose of quinine need be given on the free day, and then at any convenient hour, but preferably in the morning, after a stool, and before food is taken. On the day of expected re-

turn of the paroxysm the full dose is to be given, in the same way as before. This is to be kept up for a week or two, since some of the parasites escape destruction, and in the course of a week to a fortnight multiply sufficiently to cause relapse.

In cases in which intravenous or intramuscular injection has been employed during the first few days or the first week of the attack, administration by the mouth can frequently be substituted thereafter. If the case be of remittent or subcontinuous type, the drug is best administered every four hours in doses of from 5 to 10 grains (0.3 to 0.6 Gm.) according to severity of symptoms and individual reaction to medication..

After a sufficient continuance of full treatment—according to the type and severity of the infection, and the result as shown clinically and microscopically—the dose of quinine may be reduced one-half, and this amount given daily or on alternate days, in one or two portions. This should be continued for some two to four weeks, or longer if necessary. After that, for at least three months the patient should take a full dose of quinine (not less than 15 to 20 grains in two portions) every seventh day (not every eighth day, as every Saturday or Monday, but *anticipating one day each week*, *e.g.*, Saturday, Friday, etc.). Should symptoms recur, active, full, continuous treatment should be resumed at once.

In cases of *remittent* or *subcontinuous* type the effective dose is to be repeated daily—either by a single injection, or in fractions every three or four hours,—by the mouth. A sufficient dose should be continued during and after convalescence, as already stated.

It is necessary to keep quinine in the blood for a period of at least forty-eight hours, preferably seventy-two hours or three days. Thirty grains (2 Gm.) of quinine on each of three consecutive days always destroy all asexual plasmodia in the patient. There are no exceptions. Relapses result from reproduction in some manner not now well understood of sexual plasmodia or gametes which are usually present in variable number. They reproduce in seven days and multiples of seven days, and give rise to the relapses occurring usually on the seventh, fourteenth, twenty-first, and sometimes twenty-eighth days. C. C. Bass (N. Y. Med. Jour., Jan. 10, 1914).

From 50.77 to 68.86 per cent. of the malaria occurring in a representative malaria locality of the United States including thousands of cases, was relapse and not new infection. This indicated great inefficiency of the treatment of malaria practised there.

The chief cause of ineffective treatment was the employment of spectacular and impractical methods, and the discomfort and inconvenience of quinine given by hypodermic injection or of quinine in solution. Neither method could be continued long enough to disinfect the patient. Blood examination could not be depended upon to determine when disinfection had been accomplished. The only trustworthy guide was the length of time proper quinine treatment had been kept up. An effective and practical method of treatment to disinfect the patient after the acute symptoms had been relieved was to administer 10 grains (0.66 Gm.—proportionate doses for children) of **quinine sulphate** every night before retiring, for a period of 8 weeks. This was effective in about 90 per cent. of cases. Where there was any reason to suspect that the case might be exceptional or one in which disinfection was more difficult to accomplish, the treatment was continued for more than 8 weeks. C. C. Bass (N. Y. Med. Jour., June 14, 1919).

Dosage.—It should be evident from what has been said that the dose of quinine in malaria, like that of any other drug in any other malady, is *enough, repeated sufficiently often*. But unlike most other drugs in most other maladies, it is better to give too much than too little. Especially is this so in the tropics and other regions where severe malaria is endemic, and *a fortiori* in the pernicious forms of the disease, or even in the milder cases of infection with crescent-forming organisms. Whether or not a given dose is sufficient can be determined only by the result. When feasible, the blood should be studied for the disappearance and reappearance of organisms, and for changes in their morphology. Otherwise clinical data must be relied on. The most important is the degree and permanence of the effect in controlling or suppressing paroxysms. Among the so-called physiologic (in reality, toxic) effects of quinine, ringing in the ears, if slight, is to be welcomed. Only that quantity of drug not used up in destruction of parasites is available for such effects; and a slight tinnitus indicates, therefore, a slight excess of the drug over the absolute necessities. Severe tinnitus or ocular symptoms of any kind, however, indicate a greater excess of drug than is desirable, and this should be corrected in subsequent doses.

In ordinary cases of *simple tertian infection* as seen in temperate climates, 1.6 Gm. (24 grains) of a fairly soluble quinine salt (*e.g.*, the hydrochloride, or the carbamide-hydrochloride combination) given *by mouth* in 2 or 3 portions in the first twenty-four hours is generally sufficient. When the paroxysms recur daily (*double tertian*) this quantity is to be repeated daily. Other-

wise 12 grains (0.8 Gm.) may be given the following day—and so on, as set forth in the previous section.

The dose of quinine in children should be relatively larger than in adults. The writer follows the following plan: Drug given every two hours (4 or 5 doses daily) for three days, beginning when temperature is at its lowest, or in such manner that the last dose is taken two or three hours before the time of the expected paroxysm. For a 1 year child, 1 grain (0.065 Gm.) of the sulphate may be given at each dose; children of 18 months to 2½ years should have 2 grains (0.13 Gm.), and over 2½ years, from 2½ to 3 grains (0.16 to 0.2 Gm.). After the third day, if the condition is improved, the same dose is given *t. i. d.*; after several days more, one-half the dose is given *t. i. d.* for at least one week more. Wherry (Archives of Pediat., Apr., 1911).

A routine dose of 20 grains (1.3 Gm.) on diagnosis, and 10 grains (0.6 Gm.) three times a day later, for at least ten days, was found by Deeks noticeably to diminish the number of recurrent cases. Deeks then instituted a treatment of 45 grains (3 Gm.) per day, in doses of 15 grains (1 Gm.) each. This method has practically eradicated recurrent malaria among the Americans in the Ancon Hospital, and to a large extent among the European laborers. These latter, however, treat mild infections themselves with small doses of quinine, so producing a relatively quinine-immune asexual cycle that is more difficult to eradicate. James (Jour. of Infect. Dis., May, 1913).

The intravenous administration of acid hydrobromide in concentrated solution is the quickest and surest method of immediately cutting short a febrile attack of malaria. It appears to be a perfectly safe method, and is preferable to intramuscular injections. It cannot, however, be relied on to exterminate the parasite, and should be supplemented either at the time of that attack or subsequently

by an oral course of quinine. In many instances intravenous quinine can be depended on to save life. Probably a 5 to 10 per cent. solution of the acid hydrobromide in normal saline is best, though further work is required on quinine urethane and colloidal quinine. For an adult five consecutive daily injections are recommended. In a critical case a gram (15 grains) should at once be given intravenously. The injections should coincide with the rising temperature or with the rigor. Knowles (Indian Jour. of Med. Res., Jan., 1918).

By the subcutaneous or intramuscular route a dose of 1 Gm. (15.5 grains) of quinine and urea hydrochloride ordinarily suffices, and if this quantity be given not longer than four hours before the expected paroxysm, or even during the chill, it is frequently sufficient to prevent recurrence either for six and one-half or thirteen days, although organisms in diminishing number may sometimes be found in the blood for two or three days after the treatment, and usually reappear in increasing number two or three days before the postponed paroxysm manifests. For curative effect, it is best to repeat the injection on each paroxysm day for 3 or 4 doses, after which oral administration may be substituted, and is to be kept up *for a sufficient period*, as already detailed.

Should the quantities and frequency mentioned not have the desired effect, it goes without saying that they are to be increased; and this may be necessary from the first in *quartan* or *estivoautumnal* cases, in which 2 Gm. (30 grains) or more by mouth, or 1.5 Gm. (25 grains) by injection, may be needed daily, or at least on the paroxysm days.

In *pernicious malaria*, 1 Gm. (15.5 grains) or more of an appropriate

salt (*e.g.*, the dihydrochloride) should be given intramuscularly, or, better, *intravenously*, and repeated every two to four hours, more or less, for effect.

In *chronic*, *latent*, and *masked malaria* the attempt should be made, if possible, to provoke some frank manifestation of periodic character, according to the method of Archibald Billings, who early in the nineteenth century was accustomed, in doubtful cases of ague, to administer doses of Peruvian bark not sufficient to cure, but merely to reawaken the symptoms. The senior writer has modified this to correspond with our improved therapeutic and diagnostic facilities. An injection of 5 to 10 grains (0.3 to 0.6 Gm.) of quinine and urea hydrochloride is given and the peripheral blood examined for organisms. If these are found, and their type and period can be determined, the subsequent injections are timed, and the dose increased, accordingly. Otherwise full doses are given by mouth or by injection, at convenient times, singly or in divided portions, according to symptoms and result. In *brow ague* (malarial headache) and other forms of *neuralgia*, the neutral **quinine hydrobromide** is to be preferred, and may be given in wafer or capsule with a sufficient quantity of **ergot** to prevent tinnitus. Thus, 5 to 8 grains (0.3 to 0.5 Gm.) of quinine hydrobromide, with 3 to 5 grains (0.2 to 0.3 Gm.) of ergotin, may be taken before breakfast daily. If this dose does not prove efficacious, a like capsule may be given at night, or the daily dose of 0.6 to 1.3 Gm. (10 to 20 grains) may be divided into 3 or 4 portions. In cases showing considerable anemia, **arsenic** should be added in appropriate form and dose. Arsenic is often useful,

too, when there is no special anemia. **Strychnine** sometimes has a wonderful effect, and the association of quinine, strychnine, and arsenic is both rational and helpful. When there is *splenic* or *glandular enlargement*, **Lugol's solution**, or other form of **iodine** should be given. Iodine inunctions, with **iothion oil** (10 to 25 per cent.) or **vasogeniodine** (iodine petrox), 10 per cent. are useful. For great hypertrophy of the spleen (and liver) **ergot** may sometimes be added with benefit. In the *myalgic type* of chronic malaria, **salicylic salts**, especially **cinchonidine salicylate**, find applicability.

Contraindications.—The appearance of hemoglobin in the urine is said by some to be a toxic effect of quinine, and to indicate discontinuance of the drug. The writers have made no personal observations that will throw light on this subject. They have never seen hemoglobinuria (discernible to the eye) in cases of malaria (or, indeed, in any other infection) in which quinine has been given—even in the enormous doses they sometimes employ in acute lobar pneumonia, *e.g.*, 5 to 8 Gm. (75 to 125 grains) in twenty-four hours.

It is well known, however, that certain persons exhibit a peculiar susceptibility (so-called "idiosyncrasy") to the toxic influence of quinine. This is sometimes—but not commonly—manifested toward very small doses. Thus in a case observed by the senior writer, a child of about 6 or 7 years, who had some years earlier recovered from scarlet fever, had an attack of fever and delirium with general erythema, lasting about four hours, following a dose of 3 or 5 grains of cinchonidine salicylate. Subsequent observations showed no idiosyncrasy against other salicylic

compounds, but complete intolerance of cinchona derivatives. As in most cases of drug intolerance—and especially of quinine intolerance—the patient shows the signs of that condition which the senior writer has termed *autonomic* (or *vasomotor*) *ataxia*, and his family history is replete with instances of hay fever, migraine, hives, asthma, Graves's syndrome, visceral and vascular crises, and other autonomic and vasomotor disorders. When such an idiosyncrasy is known to exist, the administration of quinine must be carefully considered, but the question is not necessarily to be decided in the negative. The quinine reaction in the given case may be relatively unimportant; the risk of producing an eruption, itching, slight gastroenteric disturbance, even circulatory or nervous symptoms of mild degree, need not deter the physician from using the only certain means of cure in a serious infection. It is to be borne in mind, moreover, that only in exceptional instances is quinine intolerance absolute. Ordinarily a certain dose, perhaps as much as 5 grains or more, can be supported with little or no disturbance. Further, it is only *the excess over the parasitidal quantity* that produces constitutional reaction. In such cases, therefore, it is possible to avoid a severe toxic reaction by carefully choosing the time and method of administration and dose to be administered. A single dose, slightly below the average effective quantity, and at the time of election, is best, *e.g.*, if by mouth, in an ordinary tertian case, 1 Gm. (15 grains) four hours before the expected paroxysm; if by injection under the skin or into the muscle, 0.6 Gm. (10 grains) two hours before the expected paroxysm, or even during the chill.

When, however, the susceptibility is so extreme as to constitute a veritable contraindication, some succedaneum to quinine must be sought.

Succedanea and Auxiliaries to Quinine.—Not only in cases of quinine intolerance, but also in certain cases in which the cinchona derivatives are well borne, but ineffective, other agents must be employed, either in place of the specific remedy or in supplement thereto.

Modifications of the quinine molecule have been proposed, and in some cases have been successful. Among these are the substances known as **euquinine** and **dextroquinine**. Our own experience with either of them is not sufficient to warrant us in passing an adverse judgment upon it, but we have not observed any special benefit in the few instances in which we have made the trial.

The former terrible infant and child mortality in the Malay States has been entirely stopped by the employment of **euquinine**, which the writer administers to his charges in doses of 5 grains (0.3 Gm.) per diem (in a little sweetened condensed milk). Instead of the splutter and struggle experienced with the ordinary quinine salts, the children almost without exception punctually appear, each with his tin, at the time of the daily dose. M. Watson (Brit. Med. Jour., Feb. 29, 1908).

Ethylhydrocupreine, also known as **optochin**, has recently been brought forward for use in cases rebellious to quinine. It is said to be efficacious in severe quartan and estivo-autumnal infections, being toxic to the adult parasites in all stages, as well as to the early forms following fragmentation. The daily dose recommended is 1 to 1.5 Gm. (15 to 23 grains) for adults, given in 3 pow-

ders, with intervals of four hours between doses. It is said to cause the complete disappearance of organisms in from ten to sixteen hours. The duration of the treatment is said to be from one to five days, sometimes with a day's intermission.

Methylthionine hydrochloride, better known as "medicinal methylene blue" has given good results in a number of cases, but is not always to be depended upon. It is best given in capsule, in doses of about 5 grains (0.3 Gm.) each, twelve, eight, and four hours, respectively, before the anticipated paroxysm. The patient must, of course, be advised of the discoloration of the urine and saliva that will ensue. If the drug is not well tolerated by the stomach, a **digestive ferment** may be added to the capsule, and perhaps a small dose of **opium**.

Warburg's tincture has in the hands of the senior writer almost vindicated its early reputation. The action is severe and unpleasant, but the effect is beyond question. It must be used, however, according to Warburg's method, the induction of adequate perspiration being essential. It is indicated in cases of mild intolerance to quinine and in cases in which the ordinary use of quinine has been insufficient to produce complete recovery. Frequently in chronic and masked cases it is the promptest and most effective remedy at command, although it may to some extent be superseded by **salvarsan**.

Warburg's tincture is a complex mixture frankly open to the reproach of polypharmacy, since it contains no less than 13 ingredients. Its inventor, Dr. Warburg, held its composition as a secret for a time, but

finally made it public. Many modifications have been proposed, and some preparations now sold as Warburg's tincture probably contain few, if any, of the original components. Indeed, some of these are not now readily obtainable. The tincture ought to be made as nearly as possible according to the following formula:—

℞ *Aqueous extract of aloes*. 28 grains.
Rhubarb,
Angelica seed of each 448 grains.
Elecampane,
Saffron,
Fennel of each 224 grains.
Gentian,
Zedoary root,
Cubeb,
Myrrh,
White agaric,
Camphor,
Quinine sulphate.. of each 112 grains.
Dilute alcohol, enough to
 make 8 pints.

[The coarse vegetable portions of this list are to be ground into a coarse powder, and the myrrh and camphor, previously pulverized, added to them. The entire mass, less the quinine, is then digested for twelve hours in a well-covered vessel on a water-bath, the alcohol being prevented from evaporating as much as possible. The liquid is finally strained under pressure and the quinine sulphate added and dissolved.]

The patient must fast for at least six hours before treatment is begun, and take no food until the effect (free sweating) has been induced. After free purgation, $\frac{1}{2}$ fluidounce (15 c.c.) of the tincture is given undiluted, all drink being withheld, and at the end of three hours a second $\frac{1}{2}$ fluidounce is similarly given. Soon after the second dose, a violent aromatic perspiration comes on, and the fever is usually broken. The perspiration is encouraged by keeping the patient wrapped in blankets, with

external application of heat, if necessary. Sips of cold water may be taken during the pack. Warburg's tincture is more effective in chronic and relapsing cases than in the early and frank attacks.

Of late **salvarsan** has come into use in the treatment of severe and obstinate malaria, both acute and chronic, and excellent results are attributed to it. Especially in chronic estivoautumnal infection has it been lauded, destruction of the crescents, usually so resistant, being apparently accomplished quite readily in many instances.

Application of the **X-rays** in cases of malarial fever relieves splenic pain and reduces recent engorgement. The temperature falls and does not usually rise again. Recovery is not attended by the anemia usually present in cases treated with quinine. The writers have not had to fall back upon quinine in cases treated by the X-rays, while they have had cases which resisted quinine and yielded promptly to the rays. Skinner and Carson (Brit. Med. Jour., Feb. 25, 1911).

Case clinically diagnosticated as quartan malarial fever that yielded promptly to an injection of 0.6 Gm. (10 grains) of **salvarsan**. This patient had reacted only slightly to treatment with quinine. E. E. Waters (Indian Med. Gaz., Mar., 1913).

The writer has removed the enlarged malarial spleen in 13 cases and has found records of 187 others in the literature, bringing to 200 the number of cases. The mortality for the total was 25 per cent., and 3 of his 13 patients succumbed to the progress of lesions which could not be arrested by the removal of the spleen. Six of the patients were men and all were between 18 and 50. When the patients were re-examined from six to twelve months after the **splenectomy**, 10 were found well, with full earning capacity. The writer advises that one refrain from splenectomy if there is **much cachexia, hydremia, and the**

hemoglobin is below 40 per cent.; or if there is considerable cirrhosis and atrophy; if the general health is poor and there is disorder of the digestive and urogenital organs, and if there are very extensive adhesions, especially of stomach and diaphragm. The mortality at different clinics is from 7 to 60 per cent. Kopylow (Archiv f. klin. Chir., Bd. ci, Nu. 3, 1913).

The writers found that the combination of **arsphenamine** with **quinine** is much more effectual than the latter alone in malaria. They gave an intramuscular injection of 1.20 Gm. (19 grains) of quinine at the beginning or during the malarial attack, followed within 24 hours—preferably from 6 to 12—with an intravenous injection of 0.15 Gm. ($2\frac{1}{4}$ grains) **arsphenamine**. This is repeated every week, with mild tertian, increasing the dose of the **arsphenamine** to 0.30 Gm. ($4\frac{1}{2}$ grains). With malignant tertian, they give two injections of the quinine daily until the temperature is normal. Then 0.15 Gm. ($2\frac{1}{4}$ grains) **arsphenamine** is injected, and after this 2 Gm. (30 grains) of quinine by the mouth until the temperature has been normal for two days. The two drugs are then kept up once a week for two months and, during a third month, once a fortnight. **Iron** and **adrenalin** are useful adjuvants. Paiseau and Hutinel (Paris médical, March 15, 1919).

Treatment of Pernicious Malaria.

—The treatment of pernicious malaria consists in the energetic administration of **quinine**, preferably by intramuscular or, better, intravenous injection. From 10 to 25 grains (0.6 to 1.6 Gm.) of one of the soluble salts should be given without delay, and repeated at any subsequent paroxysm or, if indicated by the severity of the case, within two to four hours, and after that as necessary. When no further paroxysm develops, intramuscular injections should nevertheless be continued to the number of not less than

3 during the first week and 2 during the second.

Besides the use of quinine, prompt and effective symptomatic treatment is indicated, **morphine** being given to relieve discomfort and nausea, **stimulants** to overcome depression and weakness, **saline** purgatives to exert a derivative action in the comatose type, **opium** and **bismuth** to control diarrhea, **pituitrin**, **strychnine**, **cocaine**, **atropine**, **camphor**, or **musk** to sustain the heart and **cold sponging** or **external heat**, according to whether the temperature is febrile or subnormal, heat, of course, being employed invariably in algid cases and when collapse threatens.

Treatment of collapse in malignant ague: In the milder cases a medium dose of **morphine** ($\frac{1}{4}$ grain—0.016 Gm.—hypodermically), with **external warmth** in the form of **hot-water bottles** and **blankets**, is indicated. This is combined with **treatment of the predominating symptoms**. In the dysenteric type a **starch and opium enema** should be given, with the buttocks well elevated. If vomiting is copious and persistent, **ice pills** are given, and all **nourishment by the mouth stopped** for twelve hours. In either variety a full dose of **quinine (bihydrochloride, 10 grains—0.6 Gm.)** is given intramuscularly, and repeated each morning for three successive days. Weekly injections are, as a rule, sufficient after this. At times the peritoneal circulation can no longer be trusted as a drug carrier. **Venous infusion** of from 2 to 3 pints (1000 to 1500 c.c.) of saline fluid is then to be performed, and the quinine solution added to the saline injection. Cathcart (Jour. Royal Army Med. Corps, Oct., 1907).

Referring to a desperate case successfully treated with large doses, the writer believes that in pernicious cases with cerebral symptoms the danger is not in the method but in

the delayed use of it. The **bihydrochloride** and the **acid hydrobromide** are the best for intravenous use. The latter is much the least toxic, but contains only three-fourths as much of the alkaloid as the bihydrochloride. Ten grains (0.60 Gm.) of the acid hydrobromide intravenously are well borne, and 15 grains (1 Gm.) can be given. The case which the writer now reports received 15 grains (1 Gm.) on admission to the hospital, two 15-grain doses within the following 24 hours, three $7\frac{1}{2}$ -grain (0.5 Gm.) doses the next day, and two $7\frac{1}{2}$ -grain doses the following day, all intravenously. The patient's temperature on admission was 105-6° F., and he soon became extremely jaundiced; the urine was nearly black with bile pigment.

While as shown by a count of the malignant tertian rings 40 per cent. of his red corpuscles must have been destroyed the first day, and 19 per cent. the next day, yet the first injection completely changed the blood picture, and in two days all the parasites had disappeared. Rogers (Indian Med. Gaz., Nov., 1917).

MALARIAL CACHEXIA.

DEFINITION AND SYMPTOMS. — Repeated attacks of malarial fever—especially of the estivo-autumnal type and when inadequately treated—or a continuing and neglected infection, whether or not it has been marked by evident relapses, will give rise to a cachectic condition, marked by feebleness, indisposition to exertion, loss of appetite, occasional blood-losses, gastroenteric disturbance, and obvious anemia. Nervous symptoms may be marked. The circulation may be extremely depressed; not rarely the heart is dilated, the pulse weak, rapid, and irregular, and paroxysmal dyspnea frequent and severe. The spleen is enlarged, often hard to palpation, and sometimes of enormous size. The liver is likewise enlarged; and

there may be more or less intense jaundice. Usually the complexion is yellow and muddy, sometimes with a peculiar pallor, especially of the lips, ears, and tarsal conjunctivæ.

DIAGNOSIS.—In individuals suffering as described, especially when there is a history of fever of irregular type, recurrence, and duration, search for the malarial parasite should be made. This is peculiarly true in the tropics. The complexion, unlike that of any other condition; the presence of free pigment or of pigmented leucocytes; an increase in the mononuclear percentage; perhaps a leucopenia, and the characteristic pallor and appearance of the red cells, will help in making the diagnosis, even when the parasite is not found in the peripheral blood. Sometimes if a small dose of quinine be administered, not sufficient to kill the parasites, they will be driven out of the spleen and bone-marrow (and possibly other resting places) into the peripheral circulation in sufficient numbers for demonstration. A fair dose of strychnine may have a like result. Splenic puncture is to be undertaken as a last resort, and only in cases of absolute necessity. The anemia and other symptoms may likewise be the result of an infection that has come to an end, and if even splenic puncture fails to reveal organisms, that possibility is to be considered.

The discrimination between malarial cachexia and kala-azar may depend upon success or failure in discovering Leishmann-Donovan bodies. Quinine, it is believed, has little effect on kala-azar.

PATHOLOGY.—The pathology of malarial cachexia has been cleared up since Banti's disease and kala-

azar have been clearly discriminated from it. The principal changes are in the blood, liver, spleen, and bone-marrow.

The pathological findings in the blood usually correspond to the degree of anemia. Dionisi and Big-nami describe four types of post-malarial anemia:—

1. Cases in which the blood shows alterations similar to those observed in secondary anemia, from which they differ only in that the leucocytes are diminished in number. In these cases recovery is the rule; a few, without further change in the blood-picture, terminate fatally.

2. Cases in which the blood shows alterations similar to those seen in pernicious anemia—especially the presence of megaloblasts. These cases end fatally.

3. Cases which are progressive, as the result of compensation by the marrow for losses brought about by the infection. At autopsy, the marrow of the long bones is found to be wholly yellow, while the marrow of the flat bones is also poor in nucleated red cells.

4. Chronic anemia of the cachectic, which differs from the foregoing types clinically and anatomically in that the special symptoms of malarial cachexia dominate, while one observes *post mortem* a sort of sclerosis of the bone-marrow.

The pathologic findings in the *spleen*, *liver*, and *bone-marrow* correspond closely to the pictures presented in chronic malaria and in acute malaria tending toward chronicity. The extent and degree of the tissue changes depend largely upon the intensity and duration of the cachexia.

PROGNOSIS.—When patients are unable to leave the locality in which they have contracted the infection, the prognosis is grave, as any intercurrent disease, because of lowered resistance, finds them easy victims.

When a change of climate is possible, the prognosis, while good under suitable treatment, should always be guarded.

TREATMENT.—The drugs of chief utility are **arsenic**, **iron**, and **quinine**.

Quinine is to be administered according to the rule in chronic infections, when parasites can be demonstrated or reasonably inferred to be present.

Fowler's solution may be given in ascending doses, until the point of tolerance is attained. **Salvarsan** may be used intramuscularly in small doses (about 0.06 Gm.), repeated weekly or fortnightly up to not more than 0.6 Gm. in all. **Sodium cacodylate** or **atoxyl** can be given hypodermically in the usual doses, with caution.

Iron may be given in the form of **Basham's mixture**, the **Blaud pill**, or the **tincture of ferric chloride**. A solution containing a mixture of **iron and arsenic citrates** with **sodium phosphate** or other solution suitable for hypodermic use, may be injected as in other forms of anemia.

The "**esanophele**" pill is recommended by German pediatricists. Its formula is as follows:—

℞ *Quinine dihydrochloride* gr. iiss (0.1 Gm.).
Arsenic trioxide .. gr. $\frac{1}{64}$ (0.001 Gm.).
Ferrous citrate gr. v (0.3 Gm.).
Extract of gentian. gr. iiss (0.15 Gm.).
 Mix. For 1 pill or capsule.

The following "liquid mixture" is useful:—

℞ *Tincture of ferric chloride* ℥lxxx to f3ij.
Diluted phosphoric acid. f3ij to f3iij.
Strychnine sulphate ... gr. $\frac{1}{8}$ to $\frac{1}{4}$.
Solution of potassium arsenite ℥viiij to ℥xl.
Essence of pepsin,
Syrup of bitter orange-peel of each f3ss.
Water, sufficient to make f3ij.

Mix. Dose for an adult, 2 teaspoonfuls in water three or four times daily.

Iodine in the form of Lugol's solution (1 to 10 minims after meals *t. i. d.*), sajodin (0.1 to 0.5 Gm. one to three times daily), iothion inunction, or iodipin injection is often useful for short periods, from time to time.

Warburg's tincture has been used extensively, as in the treatment of chronic malaria.

Other measures to be employed are **hygienic**, **dietetic**, and **prophylactic**, and are elsewhere sufficiently discussed.

Observation has convinced the author that **Huxham's tincture** of cinchona bark, 1 fluidram (4 c.c.) every two hours, diluted, will cure cases of malarial relapse and chronic malaria in which quinine is inert. It will also, he believes, prevent relapses. In addition, he has had good results from a pill of reduced **iron**, 1 grain (0.06 Gm.); **arsenic**, $\frac{1}{60}$ grain (0.001 Gm.), and **quinine**, 2 grains (0.13 Gm.). He has noticed repeatedly that the provisional use of **Warburg's tincture**, or extract, is very valuable when other means have failed. It is probable that by reason of the aloes and rhubarb in Warburg's tincture or extract (with aloes), the liver and bowels are favorably affected, especially if there be a tendency to constipation. Beverley Robinson (*Merck's Arch.*, Sept., 1913).

BLACK-WATER FEVER.

DEFINITION.—Black-water fever, or hemoglobinuric fever, is a disease

probably malarial, or closely allied, in origin, characterized by the voiding of hemoglobin in the urine. It occurs principally in the tropics. (See also HEMOGLOBINURIA, Vol. V.)

DISTRIBUTION.—Comparison of the countries from which black-water fever has been reported with the geographic data concerning malaria shows that the hemoglobinuric malarial and severe malaria co-exist in the same localities. It is best known in Africa, where it has been carefully studied, chiefly by British physicians. In India its occurrence is somewhat less frequent. Comparatively few cases have been reported from our Southern States, the West Indies, Europe, (Italy and Greece), and Asia Minor. The data are still too meager for exact statement. Europeans seem to be the chief sufferers in all climates.

SYMPTOMS.—Prodromal symptoms usually occur. Loss of appetite, malaise, pain in the back and limbs, and severe mental depression may forerun the attack. The paroxysm sets in with a violent rigor, the temperature rising to 103° or 105° F., and the first water passed is black in color. Indeed this may be the only symptom. The attack is generally accompanied by severe and continuous vomiting of dark green bile—a symptom which should cause the gravest concern. Jaundice appears early and may become marked. The spleen and liver become enlarged, tender or painful. Tympanites and epigastric pain are severe in many cases, while uncontrollable hiccough adds to the patient's distress. Drowsiness develops, gradually passing into somnolence, coma, and death. The urine is ordinarily increased in amount (but sometimes markedly decreased, leading

to suppression in grave cases), and maintains its black color. When death is escaped, there is a rapid fall in temperature, accompanied by sweating and an abatement of the distressing symptoms. The urine is generally free from hemoglobin on the day following the attack, but maintains its high color.

Convalescence may be entered upon, or relapses occur, with rigors and hemoglobinuria, and death terminate the case. Thrombosis of the heart, according to Plehn, is the commonest cause of death.

The blood is usually yellow and thin when taken for smears. Microscopically, the red cells may show chromasia and basophilia, and these appearances, indeed, should be looked for in all cases of malarial fevers, as some authors assert that they show a tendency toward the hemolytic action of quinine. The count may fall as low as a million. Peculiarly, the surviving individual erythrocytes show very little sign of the destructive process.

The principal changes in the white blood cells have been noted. During the paroxysm, a leucocytosis is present, the polynuclears being markedly increased—80 to 90 per cent. Afterwards there is leucopenia, with a mononucleosis of from 10 to 20 per cent. Pigmented leucocytes can nearly always be discovered.

In black-water fever there is a reduction in the normal percentage of polymorphonuclear leucocytes, occurring within a few hours of the time of onset of the paroxysm of hemoglobinuria and persisting for several days subsequently. In all the cases of the author's series the large lymphocytes seemed to be increased from the time of onset of the paroxysm of hemoglobinuria to several days subsequently. It seems probable that this increase in the number of large

lymphocytes indicates the malarial origin of the condition.

During the course of malarial fever (especially when dealing with a chronic case in which quinine has been given) there appear to be two different agencies operating, either one of which has the power of producing hemoglobinuria; these two agencies are the malarial parasite and quinine. A. Woldert (N. Y. Med. Jour., Sept. 28, 1912).

Parasites will usually be found if the examination be made prior to the hemoglobinuric attack. Afterward they may not be discovered during life, but are generally to be found in the spleen *post mortem*. During life, quinine causes them to disappear rapidly.

The urinary condition is that of hemoglobinuria, not hematuria, and the microscopic findings will correspond. The urobilin and bile contents are high.

ETIOLOGY.—The factors causative of black-water fever cannot be given with certainty. Three hypotheses are put forth, all having the support of eminent names: 1. That it is malarial in origin. 2. That it is due to the toxic action of quinine. 3. That it is a specific infection, distinct from malaria.

The theory that it is a disease *sui generis* will be first taken up.

In cattle there occurs a well-known malady caused by a piroplasm and characterized by bloody urine; and this suggests a like origin for black-water fever. All that can be said on this head is that competent observers have sought for, but have not yet found, in the blood of patients with black-water fever, a similar piroplasm. Nor does hemoglobinuria specifically characterize the cases of piroplasmic infection in man thus far reported.

As to the quinine theory, further knowledge of the exact action of quinine in the blood is necessary before positive conclusions can be drawn. That it is hemolytic to a certain extent may be admitted, and that certain individuals show but slight resistance to its toxic action is well known. On the other hand, the drug is taken daily by thousands of malarial and other sufferers who do not pass black water. That quinine has apparently precipitated the attack of hemoglobinuria has been repeatedly observed. In fact, patients themselves will give the history of bloody urine first appearing after large doses of quinine. But this may possibly be owing to the great destruction of red blood-cells going on within the body, independently of the drug. During the actual hemoglobinuric crisis, Marchoux has found that quinine is not eliminated, but the drug reappears following the cessation of the symptom. Poch reports a case in which the red cells were diminished by 340,000, while no hemoglobin was found in the urine. These two observations tend somewhat to support the supposition that quinine is retained in the blood and exerts an actual toxic action upon the red blood-cells; but further investigation is required to determine the subject definitely.

The theory of malarial origin has in its favor the weight of tradition and many indisputable facts:—

1. No case of black-water fever is on record in which the hemoglobinuric crisis has not either supervened upon a malarial infection, or appeared in a subject who had previously suffered from repeated malarial attacks.

2. As a rule, it is the older residents in malarial districts who have had many, though slight, infections, that are the principal sufferers.

3. Black-water fever has a mortality 20 to 60 times as great as that of ordinary malaria, whence it would appear to be due to a highly virulent type of infection.

4. Statistics show that hygienic and medicinal prophylaxis reduces the liability to black-water fever.

5. Various observers, working independently and in different localities, report the finding of the malarial parasite in the blood in about 95 per cent. of cases before the attack; in 61 per cent. of cases on the day of the hemoglobinuric paroxysm; and in 17 per cent. of cases on the day following.

6. The presence of pigmented leucocytes of the mononuclear type and their increase in numbers, admittedly evidence of a malarial infection past or present, have been demonstrated in about 93 per cent. of cases observed by Christopher and J. W. W. Stevens, in Africa, and the malarial parasites were found in about 12 per cent. of their cases.

These facts prove that malaria is an important etiologic factor in black-water fever; but one must admit that it may possibly be a predisposing factor only—albeit a predisposing factor of the greatest weight. For the present, the writers incline to look upon black-water fever as a form of malaria, perhaps occurring only in persons having a special liability or in those whose quinine tolerance has been originally poor or diminished by disease—a double line of observation upon which data are wanting.

Bass has observed that calcium

salts when added in amounts but slightly in excess of the normal calcium content of the blood to cultures of estivoautumnal parasites *in vitro*, cause hemolysis of infected red cells, and possibly also of many non-infected cells. These salts do not affect normal blood similarly and the opinion is expressed that malarial hemoglobinuria is possibly to be explained through some such phenomenon.

PATHOLOGY.—Melanin is usually found in the spleen, liver and bone-marrow, and is of frequent occurrence in the kidney and brain. Hemosiderin can be found in the spleen. Pigmented leucocytes, macrophages, and malarial parasites may or may not be found. Degenerative changes may occur in all the organs; and the pictures, if at all typical, are essentially like those of acute or chronic malaria, previously described—a fact to be expected since the subjects of the disease are chiefly those who have had repeated infections.

DIAGNOSIS.—The typical attack is so characteristic that the diagnosis presents little difficulty to experienced observers.

The history, blood findings, and a careful physical examination will enable one to distinguish black-water fever from yellow fever, which is usually the main stumbling block.

PROGNOSIS.—Mild attacks have a good prognosis. When convalescence has occurred, prophylaxis and change of climate have much to do with the final outcome. The mortality is from 10 to 20 per cent.

TREATMENT.—The result of the experience of observers of black-water fever warrants the advice to

avoid quinine: first, because of its possible etiologic significance, and second, because, as a rule, the parasites rapidly disappear without it—a fact to be taken in connection with the observations of Bass, already referred to. Various authors, however, await the cessation of the hemoglobinuria, then administer quinine, some even in large doses.

Under no circumstances, as shown by a study of 514 cases, should quinine be given to a black-water fever patient during the period of hemoglobinuria, nor for several days thereafter. **Quinine** may then be cautiously begun, but it should not until several days after the urine has become free from hemoglobin. Measures which sustain the blood-pressure are urgently indicated during the period of hemoglobinuria. Of these, normal **saline solution** given by bowel, subcutaneously or intravenously, is chief. **Digitalis** and **caffeine** are of decided value. Lovelace (Arch. of Internal Med., June, 1913).

In debilitated patients and in hemoglobinuric fever the writer gives **quinine** intravenously in concentrated solutions, *e.g.*, in 10 to 15 c.c. ($2\frac{1}{2}$ to $3\frac{3}{4}$ drams) of fluid. A. D. McLean (U. S. Naval Med. Bull., Apr., 1917).

If parasites should persist with a continuance of the fever, then the question of **quinine** administration becomes one of good judgment in the individual case. It may be commenced cautiously, a few grains at a time, and increased if the patient shows tolerance. If, however, a return of the hemoglobinuria follows, quinine had better be withdrawn.

It is possible that **salvarsan** may prove of service. **Warburg's tincture** has been advised; also **methylene blue**.

The general treatment is most important. **Rest**, of course, must be absolute. Free elimination should be

obtained and it is possible that **hypodermoclysis** or even **endophleboclysis** with a slightly **hyperisotonic alkaline-saline solution** might prove useful. **Champagne** is recommended when vomiting is excessive, and is often retained when all else fails. **Nutrient enemata** are valuable. **Ice** allays thirst.

Hearsey's new treatment has proved very successful. It is as follows: As soon as possible after the onset of the disease, **calomel**, with $\frac{1}{4}$ grain (0.016 Gm.) of **morphine** hypodermically to allay restlessness and vomiting, is given, the patient is wrapped in blankets, and **hot-water bottles** are put in the bed. An hourly dose of a mixture containing liq. **hydrarg. perchlor.**, mxxx (1.8 c.c.), and soda bicarb., gr. x (0.6 Gm.) to a table-spoonful of water, is given for the first twenty-four hours, and every two hours subsequently, until the urine clears. No food is given for the first twenty-four hours unless there is an inclination for it and an absence of vomiting. Hardy (Jour. Royal Army Med. Corps, Aug., 1908).

Opium or **morphine** may be used with caution. **External heat** is useful and **nitroglycerin** may be employed tentatively to dilate peripheral vessels. **Strychnine**, **camphor**, **atropine**, and **musk** may be useful in combating a tendency to collapse. Possibly **pituitary** or **thyroid** preparations might be of service in individual instances.

Various clinicians recommend other procedures, but **general treatment**, combined with **good nursing** and the **combating of symptoms** as they arise, often suffice for successful management of the case.

SOLOMON SOLIS-COHEN

AND

LEON SOLIS-COHEN,

Philadelphia.

MALE FERN. See **ASPIDIUM**.

MALT.—Malt (*maltum*, U. S. P.) is prepared from the seed of barley (*Hordeum distichon*, order Gramineæ) by soaking them in water until soft. The water is then drained off and the grain is then placed in heaps in a darkened room; heat is spontaneously generated, and, by occasional turning, is prevented from rising too high. Under these conditions germination takes place. It is allowed to germinate until the plumule has grown to be half as long as the seed. The germination is then checked by the application of heat, which is maintained until it is perfectly dry. If the last heat be a low one pale or amber malt results; if dark malt is desired the heat applied is higher and the malt may be almost roasted. The former varieties are used in medicine, the latter for making porter and dark beers.

PREPARATIONS AND DOSE.—*Maltum*, U. S. P. (malt), consists of yellowish to brown grains with a characteristic odor and sweet taste.

Extractum malti, U. S. P. (extract of malt), is made by macerating coarsely powdered malt in an equal weight of water for six hours, adding 4 more parts of water, heating to about 86° F. (30° C.) and digesting for an hour at a temperature not exceeding 131° F. (55° C.). The starchy matter is thus changed into dextrin and maltose. The mixture is then strained under strong pressure, and finally evaporated quickly in a water bath or vacuum apparatus, at a temperature not above 131° F., to the consistence of thick honey. Dose, ½ fluidounce (16 c.c.).

Fluidextractum malti, N. F. III (fluidextract of malt), contains 25 per cent. of alcohol. Dose, 2 fluidrams (8 c.c.).

If, in making malt extract, the water is entirely extracted in the vacuum apparatus, a dry extract is obtained, which is the form used in the preparation of foods for invalids and children.

Another form of liquid malt (the so-called "diastasic extract of malt") is prepared by macerating well-malted barley in warm water for several hours; the infusion is then simmered with fresh hops at a temperature under 160° F., to retain

the diastase and other proteins unimpaired, and then subjected to fermentation. The resultant liquid contains alcohol from a trace up to 10 per cent. It resembles porter or brown stout in taste and appearance. The proprietary malt extracts are for the most part of this type, and actually possess little or no diastasic power.

PHYSIOLOGICAL ACTION.—Malt extract prepared at a sufficiently low temperature contains diastase, a ferment which in neutral or slightly alkaline media is capable of digesting starches. That such an action can be developed in the human gastrointestinal tract, however, seems unlikely, since it has been shown that even Takamine's diastase ceases to act in the gastric juice as soon as the acidity exceeds 0.1 per cent. (Cushny). It might, perhaps, digest some little starch in the mouth and stomach before its destruction by the hydrochloric acid. On the whole, malt preparations appear to be of but limited utility as starch digestants and should be considered chiefly from the mere standpoint of nutritive value.

THERAPEUTICS.—Malt is a food element, since it contains all the nutritive substances of malted barley, which is rich in carbohydrates. It is possessed of a sweet, pleasant taste and can be taken alone, on bread, or in milk. It may also be taken in the form of an emulsion with an equal quantity of codliver oil. It may serve as a vehicle for iron, quinine, the hypophosphites, cascara, peptones, etc. It is useful in the wasting diseases, especially in **marasmus** and **tuberculosis**. Extract of malt is often retained when codliver oil is not tolerated. S.

MALTA, MEDITERRANEAN, OR UNDULANT FEVER (Neapolitan or Rock Fever of Gibraltar).—This fever, called by various names, is a fever which is endemic in the Island of Malta, of common occurrence along the shores of the Mediterranean and in many parts of the tropics (India, Africa), and is more rarely met with in other parts of the world, cases having been reported in France, England, and even in the United States. It is characterized by an irregu-

lar course, undulatory pyrexial relapses, profuse sweats, rheumatic pains, arthritis, and an enlarged spleen. The incubation period varies from six days to several months.

SYMPTOMS.—The symptoms are usually pronounced, though not especially characteristic.

There is a febrile attack with periods, somewhat variable in length, of normal temperatures. The fever, while usually remittent, may be intermittent in character; as an exception it may be continuously high or low, and may change its type at any stage of the disease. The course of the disease also varies. It may be acute from the onset (malignant form), ushered in with chills and a rise of temperature to 104° or 106.5° F. (40° or 41.5° C.), associated with severe headache, lumbar pain, and general malaise. The pulse and respiration are increased, the latter more markedly. Diarrhea may first appear, to be followed later by constipation.

The subacute variety (intermittent form), the more usual, has a slower onset and more gradual development. It is in this form that rheumatic pains are most often present. In a few days the evening temperature rises to from 102° to 106.5° F. (39° to 41.5° C.) with remissions in the morning. Decline in temperature is marked by profuse perspiration.

The first attack may last from one to five days, and after an absence of fever for from ten to fourteen days a relapse occurs, but it is of short duration.

In rare cases (ambulatory form) symptoms are absent and the disease is only indicated by the presence of the infecting organism in the urine and of agglutinins in the blood.

DIAGNOSIS.—The presence of *Micrococcus melitensis* in the urine or blood, the complement-fixation test of the blood-serum, and the agglutination test of the blood are the means of establishing the diagnosis.

The blood-count is typical: the red cells are diminished, lymphocytes 50 per cent. of whites, no eosinophilia.

ETIOLOGY.—The precise cause of Malta fever was discovered by Bruce in 1887 to be *Micrococcus melitensis*, which he

obtained from the spleen pulp by cultivation, and which he established as the causal agent by the inoculation of monkeys, in which death occurred between the thirteenth and twentieth days. Clinical experience has shown that this fever depends directly on the use of goats' milk containing *Micrococcus melitensis*. Numerous cases, however, have developed in laboratory workers, in countries where the disease is prevalent, from handling cultures of the bacterium.

PATHOLOGY.—The most marked post-mortem changes are found in the spleen, which becomes enlarged and soft, and is acutely congested, while the lymphoid cells in the Malpighian bodies are much increased. There is no hyperplasia of the lymphoid tissue of the intestines nor ulceration of Peyer's patches, as found in typhoid fever. There is, however, usually congestion of the stomach, liver, and the intestines.

PROGNOSIS.—The prognosis is good, though the illness may be prolonged. The mortality is from 2 to 3 per cent.

TREATMENT.—The measures recommended by Osler consist of liquid diet during the febrile period and hydrotherapy, either the cold bath or cold pack, every third hour when the temperature rises above 103° F. (39.4° C.); otherwise the treatment is symptomatic. Methylene blue, given in cachets of $\frac{3}{4}$ grain (0.05 Gm.), two or three times daily, combined with milk-sugar, 4 grains (0.25 Gm.) when digestive disturbance is present, has been suggested.

Stimulants, in the form of champagne or brandy, may be necessary in severe cases to counteract cardiac and general depression.

The prophylaxis consists in the avoidance of goats' milk. If it must be used, pasteurization of infected milk for twenty minutes at 145° F. (63° C.) will destroy the virus. Condensed or evaporated cows' milk may be used to replace the goats' milk. While the disease has no active effect on goats, its eradication is important. Vincent (1918) advocates active immunization of goats with *M. melitensis* and paramelitensis strains, each cubic centimeter of vaccine containing about 2000 millions of organisms. S.

MAMMARY GLAND AND LACTATION, DISORDERS OF. ANOMALIES OF THE MAMMARY GLAND.

—These consist of absence (*amastia*), incomplete development of (*micromazia*), and supernumerary (*polymastia*) glands.

Amastia.—Absence of both breasts is an extremely rare anomaly and is usually observed in women who are otherwise deformed, *i.e.*, monsters. The absence of one breast may be seen in a very few isolated cases. Greenhow reported a case of absence of the ovaries, with congenitally defective uterus, in which the *mammæ* were absent, though there existed depressed rudimentary nipples and *areolæ*.

Micromazia.—Incomplete development of the *mammæ* is rare, and is usually associated with some genital trouble. It may be the result of faulty development from misfitting clothes, lack of proper physical exercise, etc., prior to puberty.

Polymastia.—Accessory breasts are found in probably 1 out of every 1500 to 2000 women, while the condition exists more frequently in men (Bruce and Lichtenstern), probably 1 in 500 to 1000. They rarely attain any considerable size and are rarely provided with nipples. They are usually located in the axilla or on the chest or abdomen. All of the glands may secrete milk during normal lactation in the female. Ahlfeld contends that the abnormality is the result of transference of mammary tissues in the early stage of development by means of the amniotic cells, which ordinarily go to form the breasts, but in this instance are distributed to the other parts of the body. Heredity no doubt plays an important rôle in their

production. The largest number of breasts observed in any one person, to date, is 10.

A certain relation exists between *polymastia* and tuberculosis. *Poly-mastia* is found more among the tuberculous, especially pulmonary, patients than among the non-tuberculous. The former are nearly twice as numerous as the latter. Those who have *polymastia* are more liable to be affected by tuberculosis than those who have not. Iwai (*Lancet*, Oct. 5, 1907).

Case of a woman who had from childhood a swelling under each arm. When she became pregnant the swellings increased in size, became painful, and interfered with the use of the arms. Three years later the same conditions recurred during another pregnancy and the tumors were removed. Microscopically they showed the structure of a secreting gland. Hayles (*Lancet*, Dec. 21, 1907).

Case of unilateral axillary mammary gland which appeared at puberty, and was troublesome when actively using the right arm. It was perfectly normal in appearance and continued for a protracted period unrecognized until lactation was stimulated. On the birth of her first child it actively secreted milk. F. J. Hirschboeck (*Jour. Amer. Med. Assoc.*, May 11, 1912).

Case of supernumerary axillary mammary glands in a primipara aged 22 years. A tumor as large as an orange was found in each axilla, lying between the *latissimus dorsi* and the *pectoralis major*, and separated from the normal breast by a distance of 1 inch. It had 2 small nipples, $\frac{1}{8}$ inch in diameter and the same in height. A milky fluid escaped from both on slight pressure. These glands increased in size until the sixth day of the puerperium, and then gradually diminished until the fourteenth day, when only the nipple and the *areola* remained. Cantwell (*Jour. Amer. Med. Assoc.*, Mar. 16, 1912).

Hypertrophy.—Non-pathological excessive development of the mammae, while observed more frequently than the former conditions, is also of rare occurrence. There seems to be a predilection for young unmarried women, both breasts usually being implicated, and occasionally attaining immense proportions, necessitating amputation. In some of the indigenous negroes, the female breasts are naturally large and pendulous. Gould and Pyle record a case in which the breasts were sufficiently pendulous to be easily thrown over the shoulder during nursing. The anomaly is occasionally observed in the male sex. Moderate hypertrophy is not a contraindication to nursing. Lactation sometimes diminishes the hypertrophy. (See also PATHOLOGICAL HYPERTROPHY under TUMORS, this article.)

Case of double mammary hypertrophy. The patient was a girl of 13, of good family history and previously of good average health, but nervous. The breasts began to enlarge in June, 1905, and when examined in October they had reached an estimated weight of about 12 pounds each. In July, 1904, when about 14, her total weight was 106 pounds, more than half of which was contributed by the enlarged breasts. On July 14th, the left breast, weighing 25 pounds after amputation, was removed. On August 12th the right breast was removed; it weighed 26 pounds. Recovery was apparently uneventful; she had her first menstruation six weeks after the second operation and has been regular since. She was married in 1909 and has given birth to a six-month-developed child. H. Albert (Jour. Amer. Med. Assoc., Oct. 15, 1910).

Case of hypertrophy of the breasts at puberty. The patient's mother had had a similar hypertrophy at the

same period of life. Removal of the breasts in 25 cases on record gave good results in every instance. The breasts were shaped like watermelons, and reached below the umbilicus. Caubet (Arch. de méd. des enfants, Mar., 1911).

Two cases of enormous hypertrophy of the breasts in women of 23 and 27. The mammae were of normal size until the age of 21 and 18 respectively. In the second case the breasts weighed separately 4.2 and 2.9 kg. after their removal. The enlargement seems to be merely an exaggeration of the physiological development of the breast. It may occur in the newly born, at the time of puberty or during a pregnancy, or without any connection with birth, puberty, or pregnancy, but 63.9 per cent. of the 72 cases found on record occurred in connection with puberty; 22.2 per cent. were connected with a pregnancy; 4 cases were in newly born infants. A. J. Juhle (Nordiskt med. Arkiv, vol. xlv, Surg. Sect., No. 3, 1913).

NIPPLES, ANOMALIES OF.

Congenital absence of the nipple rarely occurs, while acquired absence is usually the result of injury or supuration of the infantile breast.

Flat or depressed nipples (microthelia) may be congenital or acquired. The acquired form is ordinarily the result of corset pressure. By reason of this fact the condition exists more frequently than abnormalities of the gland proper. The so-called inverted, or decidedly depressed, nipple renders nursing impossible without the shield. If only moderately depressed, systematic **massage**, or careful development with the **suction pump**, during pregnancy will obviate much difficulty in nursing subsequently. No manipulation should be practised, however, during the period of the month corresponding with the regular

menstrual period, because of the tendency to produce abortion.

ULCERATION OF THE NIPPLE.

Erythema frequently occurs as a complication of lactation, particularly in primiparæ. Far more distressing, however, is a condition due to the fact that the colostrum causes maceration of the epithelium of the nipple; small vesicles appear, which, if not arrested by timely treatment, generally rupture. The *erosions* thus formed become covered with scabs, under which healing would normally occur; but sucking being continued, the erosions are transformed into ulcerating fissures, which sometimes involve quite deep destruction of tissue. Occasionally the small vesicles, instead of being discrete, become confluent, and, the entire epithelial covering of the nipple being compromised, a raspberry-like nipple results. These conditions are sometimes greatly aggravated by an unhealthy condition of the infant's mouth, which should always receive considerable attention, as cleansing with boric acid solution, before and after nursing and certainly when mammary disorders are present.

Fissures of the nipple are exceedingly painful, as already stated. They are most frequently met with at the apex and the base of the nipple, where it meets the areola. In the latter case the suction, made by the child in nursing, tends to tear them open; hence the excruciating suffering induced. They usually appear the fourth day, but sometimes earlier, and quite marked febrile symptoms may be induced.

TREATMENT.—It is evident that the prevention here, first, of the pri-

mary irritation and, if this is present, of the secondary manifestations, is indicated. Scrupulous cleanliness of the nipple will prevent accumulation of colostrum and the primary erosions; hence this should be insisted upon. Both nipples should be carefully washed with a weak **boric acid solution** not only after nursing, but immediately before, and they should be carefully dried.

When local lesions exist, **suspension of lactation on the affected side** and, instead, milking the breasts by gentle **palmar massage** cause them to disappear in a few days, provided adequate cleanliness is insured. When but one nipple is involved, therefore, it can be allowed to rest, the other being used for suckling. Buccal suction, by the nurse or the husband, was formerly recommended; but the condition of the mouth being unknown, emptying the breasts by palmar massage is preferable.

Simple *erosions* usually yield promptly to the daily applications of **compound tincture of benzoin** and the application of **bismuth subnitrate** and **castor-oil emulsion** after each nursing.

Eczema of the nipples is sometimes taken for simple erosions, but it yields to the same measures. The **salicylic acid ointment** is also of value.

When *fissures* are present, the same measures are indicated, but in addition stimulation by means of **nitrate of silver** is required. The nipple being washed and carefully dried, the mitigated stick, finely pointed, is gently applied to each fissure; the moisture within the latter affords precisely that needed to obtain the best effects from the remedy. Care should be taken not to touch the surface of the nipple.

When both nipples are affected, the infant should be given the breast as early as practicable, *i.e.*, as long as the mother can stand the pressure of the secretion. Prior to each nursing the nipple should be carefully washed and a **nipple-shield** employed to protect it. The infant sometimes shows evidence of ill humor and refuses to suck through them; but a little patience usually controls the situation. A glass shield with an India-rubber tip is to be preferred, providing caution be taken to avoid bruising the breast and establishing an areolar inflammation. It should be kept scrupulously clean and washed immediately before and after using. If the infant refuses to use the tip, wetting the latter with sweetened water generally acts as an inducement. The remedial measures already indicated are then resorted to.

For several years the writer has employed a 3 per cent. solution of **methylene blue** as a topical application to the nipples, during nursing, in order to prevent and cure fissures or excoriations (*Gaz. méd. de Paris*). The results are alleged to be excellent; the method is convenient, economical, and does not require any precautions as to nursing. Both the nipples and the mouth of the child should previously be washed with a warm solution of **sodium bicarbonate** (2 per cent.). Then, with a piece of absorbent cotton on a probe, the solution of methylene blue is to be applied to the nipples. This is best done immediately after nursing, when the nipples are at the maximum of erectility. Dresch (*Charlotte Med. Jour.*, Feb., 1908).

The other disorders to which the nipple are subject are so intimately connected with those of the mammary gland proper that they cannot be treated separately.

MASTITIS.

Three forms of inflammation of the mammary gland are recognized: the *subcutaneous*, the *parenchymatous*, and the *submammary*.

Subcutaneous Inflammation.—This is not frequently met with and, though it may present itself in various parts of the organ, it usually confines itself to the areola. It is always due to infection through the lymphatics. The gland proper is not involved. Its development is that of an ordinary pimple or boil. The spot first becomes red, warm, and extremely sensitive. When located in the areola, several small, boil-like projections usually present themselves, which ordinarily proceed to the stage of supuration. They sometimes assume an erysipelatous character.

Parenchymatous Mastitis.—An inflammation of the gland proper, terminating in resolution or abscess formation. There are two distinct forms: one beginning in the interstitial tissues, when the acini become involved; in the other the inflammation develops in the acini and the interstitial tissues become involved. It was formerly believed that impediment to the escape of milk, through obstruction at the nipple by stagnant milk, epithelium, etc., gave rise to this condition, but modern researches have shown that all forms of mammary abscess are of microbic origin. Microorganisms originating from the infant's mouth or from hands contaminated with lochial or decomposition products from the gland, that have accumulated on the clothing and become infectious, infect the nipple and readily reach the deeper parts directly or through the lymphatics.

The first sign is the presence of in-

duration of the tissues of the organ. At first no suffering is experienced, but pain is finally noticed while the infant is suckling. The presence of an inflamed area with heat, redness, and swelling now becomes manifest. The hard mass previously noticed becomes very sensitive and edematous, and the organ, as a whole, becomes heavy. Should the inflammation persist for more than thirty-six hours it has gone beyond the resolution stage and, if in the parenchyma proper, there will be a chill, with sharp temperature rise, rapid pulse, etc. If primarily in the interstitial tissues there will occur rigors only. Rigors or a distinct chill indicate impending abscess formation. The skin over the abscess finally becomes purplish and less tense, and fluctuation is soon obtained. When several foci of inflammation are present, they may suppurate successively, and the series of abscesses thus developed may destroy the entire gland, and the sufferings of the patient continue months. Septicemia and gangrene sometimes complicate such cases. Even in the comparatively benign cases generally met with, the general symptoms are sometimes quite marked.

Submammary Abscess.—The space between the gland proper and the pectoral muscle over which it lies is furnished with a pad-like layer of connective tissue. Occasionally this becomes the seat of an abscess, the result of extension of the inflammation from the gland proper,—encouraged oftentimes by the use of ice-bags, when used at any time except in the beginning. When the suppuration is extensive, the breast is raised and may be moved from side to side. The local symptoms differ entirely from those of the

former condition. There is but little redness, but the tissues at the base of the organs are edematous and the neighboring glands are generally enlarged and painful to the touch. There is a deep-seated, dull pain, radiating to the arm and often increased by the motion of the latter. There is a chill and marked fever, especially when the pus has formed, and lasting until the latter is evacuated. Pus usually points not far from the axilla, and when the abscess opens of its own accord, which rarely happens, a fistula may ensue. It may point in the direction of the lacteal ducts, a puriform fluid then being secreted with the milk.

Five cases of chronic mastitis. It occurs both in nulliparæ and either during or outside of pregnancy. In 4 of the patients no exciting cause was found. In 1 there had been a traumatism. The duration varied from fifteen days to two years. Either breast is affected with the same frequency, the favorite location being the upper and outer part of the affected breast. In young women especially, the use of **iodides** internally and a **binder** may induce resolution. In elderly women chronic mastitis may lead to cancer, and in such cases the **removal of the breast** is indicated. B. Formiggini (*Riforma Medica*, Apr. 6, 1907).

Chronic traumatic mastitis may be caused by a corset which has not been made on hygienic principles. Some patients realize that the corsets are causing the trouble, and come to the physician with the bones and steels bent, broken, or removed; or have already adopted a form of corset designed to remedy the condition, after having consulted a corsetmaker. Cheatle (*Brit. Med. Jour.*, Mar. 4, 1911).

Mastitis in nursing women is almost always due to stasis, caused by insufficient evacuation of the

glands. The infection of the stagnant secretion is due to bacteria which under normal conditions vegetate in the lacteal ducts without giving rise to any mischief. If infection, as is commonly assumed, resulted from fissures we would more frequently observe cutaneous inflammations, phlegmons, or erysipelas of the integument of the breast. A. Schiller (Wiener klin. Woch., Nu. 26, 1911).

PATHOLOGY.—In parenchymatous inflammation, according to Blumm, the rapid proliferation of micro-organisms in the gland structures causes fermentation of the milk, and transformation of its sugar into lactic and butyric acids. The casein becoming coagulated, the glandular structures become engorged with the coagula, and inflammatory changes soon follow. The periglandular tissues become infiltrated with bacteria and leucocytes, while the epithelial cells lining the glandular structures swell, desquamate, and disappear. Purulent miliary foci soon form in great numbers, and adjacent foci unite. Irregular cavities are thus formed and crossed by shreds of partially destroyed tissues. In the walls of these cavities leucocytes accumulate, which stop the progress of the microbes, preventing further spreading of the process of disintegration.

TREATMENT.—The treatment of *subcutaneous inflammation* of the breasts in the early stages requires supportive measures and the application of a **boric acid-alcohol** solution or 25 per cent. **ichthyol**; in the event of abscess formation **incision** and **evacuation** of the pus, followed by **antiseptic dressing**, are indicated. It is not always necessary to remove the child from the breast in this form of mastitis.

The use of an ice-bag is a confession of inefficient prophylaxis. The prophylactic care of the breasts of nursing mothers is as follows. **Surgical cleanliness** daily carried out with as much care as for preparation for an operation on the breast. **Rest** for the nipple and for the breast as for other organs that must functionate though temporarily crippled. **Dry and moist heat** and **pressure**, properly utilized for their well-known hydro- and mechanico-therapeutic values. The means of utilizing these principles are the lead shield, hot-water bags or hot compresses, and the mammary binder. R. C. Norris (Amer. Jour. of Obstet., vol. lxxvii, 46, 1918).

The treatment of subcutaneous inflammation does not always vary from that indicated for the nipple. An important point in this connection is that any **incision** made should **radiate from the nipple**,—i.e., cutting away from the latter, toward the periphery of the breast, as the spokes of a wheel radiate from the hub. The milk-ducts are thus avoided, and a free incision can be made without danger, if it is necessary.

Solution of **rubber and benzin** with 1 per cent. **formalin** is useful as a protecting coat for the skin. The benzin evaporates, leaving a thin, impervious coating fitting tightly over the skin, while the formalin has direct bactericidal action. The writer first cleanses the parts with **iodine-benzin**, then paints them with tincture of **iodine**, and then applies the rubber mixture. This preparation before laparotomies and vaginal operations has been found successful in eliminating all tendency to wound infections. Applied to the nipple, it protects it against cracks and fissures, and thus tends to ward off mastitis. Döderlein (Centralbl. f. Gynäk., Bd. xxx, Nu. 49, 1907).

The writer found in a large number of superficial abscesses in various parts of the body that, by simple

puncture and evacuation of pus, followed by irrigation with a solution of **mercury bichloride** and subsequent injection of tincture of **iodine**, or of **Lugol's solution**, the abscesses healed with great rapidity and insignificant scarring; he adopted this plan of treatment in 6 cases of breast abscess, with encouraging results. S. Seff (Amer. Jour. of Surg., July, 1911).

Bier's method applied to the treatment of mastitis in its various forms is of the highest value. It consists in applying, as soon as the initial symptoms of the lymphangitis make their appearance, a large cup over the inflamed gland for ten minutes three or four times daily. It gives constant success upon the condition that it is applied as soon as the infection makes itself evident, that is to say, when the lymphangitis or galactophoritis is in an early stage, before the glandular *culs-de-sac* or the surrounding tissues have become invaded. Under these circumstances the pain rapidly disappears, the tumefaction diminishes, and the glands retain intact their essential anatomical elements, so that nursing may be resumed very shortly.

Mesnard undertook a long series of experiments at the St. Antoine Hospital, and notes that Bier's method gave favorable results as compared with other methods. Thanks to this treatment, systematically applied from the first of March, 1908, to June 30, 1909, only a single case of mammary abscess occurred in the lying-in department of the above-mentioned hospital.

Experience with 15 patients confirms the benefit from **Bier's cupping-glass treatment**. Mastitis thus treated does not impair the mammary function later. The pain was relieved at once and healing hastened.

The only disadvantage of the method is that it requires the constant oversight of the physician. Heinsius (Deut. med. Woch., Dec. 19, 1907).

The bell must be large enough to embrace the whole breast, and incisions should be made early, each fully 1, 2, or 3 cm. long. It is unnecessary to drain. Pain is relieved at once and the fever reduced. This is by far the best treatment of mastitis known to date, except for the subacute, nodular, non-suppurative forms. Exploratory suction shows by the circumscribed redness exactly where to incise for the abscess. The treatment is a boon to suffering humanity, when rightly applied. Hartmann (Münch. med. Woch., Bd. liv, Nu. 6, 1907).

In 50 cases of acute mastitis developed within two weeks after childbirth **Bier suction glasses** were applied in 33. The results were bad: the suction seemed to increase the tendency to suppuration and lengthen the course of the affection. On the other hand, the effect was most excellent when the affection had progressed to the stage of abscess formation. Very small **incisions** sufficed then to complete the cure under suction treatment. Zangmeister (Deut. med. Woch., Feb. 6, 1908).

Minute **incision with Bier's suction treatment** for circumscribed mammary inflammation has given the best results at Bardenheuer's clinic. For interstitial mastitis the breast is turned back, and the abscesses are **incised and drained**. The 10 cases in which this was done were cured by this single and simple operation, which yields cosmetically the best results, with merely a linear scar at the edge of the breast. Feinen (Deut. Zeit. f. Chir., Sept., 1908).

The writer used **Bier's suction** in 7 cases of abscess of the breast with excellent results in 6 cases and failure in 1. R. L. de Normandie (Boston Med. and Surg. Jour., May 13, 1909).

In Pfannenstiel's clinic at Kiel during the last four years 44 patients

with acute mastitis were treated with Bier's cupping apparatus. Abscesses developed in 9 per cent.; this complication was probably due to defective technique, the suction being applied too vigorously. Nutritional disturbances are liable to be induced by overenergetic suction, with the formation of an abscess in consequence. **Bier's suction hyperemia** proved superior to all other methods of treating acute mastitis if correctly applied, but the slightest excess in intensity soon avenges itself. Jager (Deut. med. Woch., Apr. 8, 1909).

The writer has treated successfully 30 patients with **Bier's method**. Graham (Edinburgh Med. Jour., Nov., 1909).

Bier's stasis hyperemia gives a prompt cure in the early stages and prevents suppuration. If pus has formed, nursing should be continued on the healthy as well as the affected side if the abscess is so situated that the nipple need not be bandaged. Large incisions and drainage are preferable to punctures and hyperemia. As soon as possible after operation the child should be allowed to nurse on the affected side. As a rule, normal lactation is restored within a few weeks. Schiller (Wiener klin. Woch., Nu. 26, 1911).

At Basel the woman's breasts after the birth of a child are kept constantly covered day and night with a little pad of gauze moistened with a 4 per cent. boric acid solution. A piece of rubber tissue overlaps the pad and sticks to the skin, and a towel is then laid over both breasts. The pads are renewed each time after the infant nurses. By this simple means since 1904 the proportion of cases of puerperal mastitis has dropped from 6 to 0.9 per cent., and suppuration occurred in only 0.2 per cent. in 8528 parturients.

The mastitis is treated with 5 per cent. phenol-glycerin dressings and ice, suspending the breast to insure keeping it still, drawing the milk with a breast-pump, and evacuating

pus through a minute incision, introducing the finger or forceps to reach all the foci. Bier's method of suction hyperemia has not proven satisfactory. It spares the incision, but this is outbalanced by the liability to local erysipelas and other complications. Eicher (Beiträge z. Geburtshilfe u. Gynäk., Bd. xvii, Nu. 2, 1912).

The writer recommends frequent aspiration and the use of continuous pressure. The principle of this is that the aspirations be repeated frequently enough to keep the pus cavity dry and that the continuous pressure be sufficient to prevent the blood current from showing in the mammary veins. The cases reported show that the abscesses so treated heal in from 4 to 9 days. I. Gardiner (Trans. Amer. Med. Assoc., June 12, 1919).

In *submammary abscess* the gland projects outward and seems to rest upon a pillow of fluid. The quantity of pus is sometimes very great,—over a pint,—the connective tissue yielding on all sides to form a large cavity or pocket. When the abscess does not point in any special direction, the presence of pus may be determined by means of an aspirator needle inserted at the base of the gland. An incision can then be made at the lower border of the gland, the incision always radiating from the nipple. If the breast is pierced, a better method is to make an incision at the lower border of the gland, lift it up, and evacuate the pus from beneath. The pus being finally evacuated with antiseptic precautions, the abscess should be washed out with a 2 per cent. solution of carbolic acid or boric acid, 2 parts, and alcohol, 1 part, and drained with iodoform gauze.

Analysis of 41 cases of cold retro-mammary abscess. Active surgical measures are here indicated. Puncture and modifying injections should not be considered, as the primary

lesion is retrocostal or pleural and practically inaccessible. The question whether to operate or not is merely the question of the patient's ability to endure the operation. Har-douin and Marquis (*Revue de chir.*, July 10, 1908).

The writer offers the following advice: 1. Do not open any but the most superficial breast abscess without nitrous oxide or ether. You will hurt the patient and not do thorough work. 2. Do not drain any but the most superficial abscess with gauze or rubber tissue. Use a soft fenestrated rubber tube and leave it in till all deep pus is out of the breast. 3. Do not irrigate a breast abscess. You will spread pus and organisms about inside the breast and do more harm than good. 4. Do not use hydrogen peroxide in a breast abscess, as it will act in the same way and tend to spread infection rather than to lessen it. Coues (*Boston Med. and Surg. Jour.*, July 27, 1911).

In *parenchymatous inflammation* the infant must be weaned; otherwise, the lesions will proceed from bad to worse. The breast must be immobilized with a snugly fitting **breast binder** or **adhesive straps**. **Ice-cold compresses** may be used in the very early stages, but not later, frequently renewed. The application of equal parts of a saturated solution of **boric acid** and **alcohol** is valuable. A weak solution of **bichloride of mercury** may be applied every three hours and kept moist with a covering of impermeable dressing. **Belladonna ointment**, and **lead-water** and **laudanum** are recommended by various clinicians. **Saline cathartics** are useful as derivatives, provided the patient is not too weak. Fluidextract of **phytolacca decandra**, internally, is sometimes of value when the inflammation is inclined to be sub-acute or chronic.

When the presence of pus is ascer-

tained, it should be evacuated under strict antiseptic precautions, an **incision** $\frac{1}{2}$. inch in length, radiating from the nipple, being made in the most dependent portion of the organ. The cavity is then washed out with an antiseptic solution. When the abscesses are multiple or involve a large portion of the gland, **counterdrainage** is indicated, with **iodoform gauze** or **rubber tubing** or the **cigarette drain**.

Pulverized **boric acid** applied in substance to the incision is a powerful but non-toxic disinfectant which dissolves in warm secretions and penetrates all the crevices of the wound. The writer has long applied this technique for suppurating wounds and abscess cavities, filling the cavity with the boric acid and leaving it for a day or so. Hirsch (*Deut. med. Woch.*, Apr. 7, 1910).

Suppuration had been going on in the writer's 13 cases fourteen weeks each, and the patients were discharged cured in an average time of five and a half weeks each from the commencement of **vaccines**. In 1 case there had been recurrent abscesses for fourteen months, and the breast was a mass of fibrotic tissue—a pure culture of streptococcus was present in this case, and cure was only complete after six months' treatment. In another case sinuses had been present for eight months, and the patient was discharged cured in five and one-half weeks. In 2 other cases of six months' duration cure was complete, in 1 case in two and one-half weeks and in the other in five weeks. Benians (*Brit. Med. Jour.*, Apr. 15, 1911).

Good results are obtained by treating an acute mammary abscess by **Mundé's sponge compression method**. A large, flat, coarse bathing sponge is hollowed to admit the breast, is freed from foreign matter, and treated with hot **phenol** solution. The abscess is opened over the seat of fluctuation by an incision radiat-

ing from the nipple, the **pus evacuated**, and the **abscess cavity washed out** with a mild **antiseptic** or **saline solution**. The sponge is then dipped in hot sterile or carbolyzed water and wrung out in a towel. It is then placed over the breast, the walls of the cavity being held in apposition; is covered with oiled silk, and is evenly and firmly compressed against the thorax with wide rubber bandages. This dressing is changed daily, and the sponge cleaned, but the abscess cavity not interfered with. Dearden (*Am. Jour. of Surg.*, Oct., 1912).

The writer has found Chaput's **fili-form drainage** with thread, wire or a very fine bougie a great improvement over other methods. The thread is drawn entirely through the abscess, and drainage proceeds incessantly and effectually, the minute openings in sound tissue not filling up, as they are free from dead space, while they do not favor introduction of air, are painless and do not bleed. Di Sant' Agnese (*Policlinico*, July 15, 1917).

The general health requires considerable attention, the strength of the patient bearing considerably upon the recovery. Good food, tonics, and pure air are important adjuvants.

GALACTOCELE.

This condition is due to occlusion and distention or rupture of one or more lactiferous tubes. In the latter case the milk permeates the connective tissue of the gland.

SYMPTOMS.—Two varieties of this rather rare condition are met with: in the one the accumulation of milk, within the duct or the connective tissue, occurs near the nipple and superficially. The appearance is typical: more or less large, knob-like projections or swellings form at the apex of the gland. It usually appears suddenly while suckling the infant, when rupture of the tube occurs without causing much local distress. In

simple dilatation from occlusion, which may occur during pregnancy, although more frequently during lactation, the growth is gradual.

The second variety of galactocoele occurs in the substance of the organ, forming one or more irregular lobular projections, which are quite firm under pressure, especially in cases of long standing. In the latter, when due to rupture of the ducts, the accumulated secretion is often found hemmed in by a protective cyst-wall. When the duct is simply dilated, the wall is formed by the lactiferous tube itself; this form likewise appears more or less suddenly. In some cases the gland becomes very large, and as much as 5 quarts of serous, milk-like fluid have been withdrawn by means of the trocar. There should be no enlargement of the axillary glands.

TREATMENT.—Aspiration is sometimes sufficient to cure small cysts; but in the majority of cases, it is best to **open** the distention antiseptically and to **drain**.

BENIGN TUMORS.

Benign tumors of the breast include *hypertrophy*, *adenoma*, *fibroma*, *lipoma*, *myoma*, *calcification*, *osteoma*, *dermoid* and *hydatid cysts*, besides *galactocoele*, which has been described.

Every palpable mass in the breast of a woman should be regarded as malignant until proof is obtained of its benignity. Previous to the age of 25, lesions of the breast are, as a rule, benign. They include intracanalicular myxoma, fibroadenoma, and diffuse virginal hypertrophy. In women over 25 every tumor of the breast should be explored without delay. They may be malignant or doubtful. Bloodgood (*Amer. Jour. Med. Sci.*, Feb., 1908).

Tumors of the breast, though rare in children, occur in both sexes and

at all ages. Benign tumors in the young are more common in mammary gland than the malignant, the most common varieties being fibro-epithelial growths and angiomas. Sarcomata are rare and carcinomata almost unknown before puberty. Girls are less often affected than boys, but the difference is not so great as in adults. Angiomas are usually congenital or appear in infancy; fibroadenomata develop as puberty is approached. The smaller benign tumors may cause no inconvenience, or they may give rise to pain, tenderness, and inconvenience on account of their size. Sarcomata show the symptoms usual with that form of tumor. Jopson, Speese, and White (*Annals of Surg.*, Nov., 1908).

HYPERTROPHY.—The condition referred to here is a pathological rather than an anomalous condition such as that referred to in the earlier part of this article. Its onset is quite insidious: the breasts begin to swell and steadily increase in size within a few months, until they have attained quite noticeable proportions. The enlargement may affect both organs, but sometimes only one of them, *i.e.*, when the process follows traumatism. The breast keeps the shape of a hemisphere, but it is much firmer than usual. When, however, it has become very large, its weight causes it to fall below the abdomen, sometimes down to the knees, the upper portion forming a more or less large cutaneous pedicle. It sometimes assumes very great dimensions. There is no tendency to spontaneous recovery in the virginal type, while in gravidity spontaneous recoveries have been observed.

The menstruation, as a rule, is disturbed. Pains appear, which, though rare at first, become more and more pronounced. The patient, how-

ever, complains especially of extreme fatigue caused by the enormous weight. In some cases the breasts acquire almost incredible proportions, one-third the body weight; the patient loses her appetite, and occasionally dies of weakness and prostration, the autopsy showing no other alteration than the enlargement. The chief part of the hypertrophy is due to an



Hypertrophy of the breasts during pregnancy.
(*Wissaupt.*)

increase of the connective tissue. Microscopically the tissues resemble very closely adenofibroma.

Treatment.—Iodide of potassium used early and in large doses and moderate pressure exerted by means of a flannel or rubber bandage sometimes retard or arrest the growth. If the tumor continues to grow, complete **excision** is the only treatment. Lactation seems to cause diminution, and has been followed by a cure in a few instances. The oppo-

site may be the case, however, as in the patient shown in the illustration.

INTRACANALICULAR MYXOMA.—Closely allied to the above form, this variety of tumor is that most commonly met with in the young female, developing most frequently during puberty hypertrophy. The hypertrophy is limited to the intralobular stroma of the gland. It is subject to the same treatment.

In case of myxoma of the breast the tumor was so large and cumbersome that the patient, when sitting down, was obliged to rest it on a table or on the arm of a chair. The patient was only 38 years old and the tumor, which weighed 16½ pounds, was first noticed three years previously. It was entirely discrete and was removed easily. During the last two or three months the tumor had grown very rapidly, due to a sarcomatous metaplasia. *Graves (Boston Med. and Surg. Jour., Apr. 18, 1907).*

ADENOFIBROMA.—Adenofibroma is frequently observed, and may appear at any age, but is usually met with between the ages of 15 and 45 years—during the sexual life. Menstrual disturbances and contusions of the breast are thought to exert a certain pathogenic influence.

Symptoms.—Adenofibroma grows insidiously; pain is only present in exceptional cases, and is usually increased during the menstrual period. The growth rolls under the fingers, and its surface is generally irregular, though the skin is unchanged and elastic under pressure. The nipple is not retracted, but there occasionally exudes from it a serosanguineous fluid.

The subcutaneous veins are only slightly, if at all, dilated, except when the tumor is very large. The axillary

glands are usually normal, and the patient's general health is good. Very rarely these growths have been known to attain a considerable size in a short time, and the distended skin to become thinned and ulcerated; but the cutaneous tissues remain free and loose, and the ulcerative process presents none of the characteristics of cancerous ulcerations.

Treatment.—The progress of small adenomata may be retarded by the local use of **iodine** and by **slight compression**, but, if they continue to increase in size, they should be excised. It is important to remember that the **excision** should be complete, the least remnant becoming a focus of recurrence.

Adenoma of the primary type or stage in persons under 30 years of age may be removed together with its capsule and a wide margin of the adjacent stroma and a very favorable prognosis given; but in women over 30 years of age, even this type may be potentially malignant. Cases of secondary hyperplasia should be considered as precancerous. *Gillette (Trans. Amer. Assoc. Obstet. and Gynec.; Oct. 25, 1919).*

LIPOMA.—Lipoma may exist in the breast in single or multiple form. A small lipoma would only be recognized by an exploratory incision, while a large growth should not be difficult to differentiate from an intracanalicular myxoma, which it most resembles.

CALCIFICATION.—Areas of calcification have been observed in the walls of simple cysts by Billroth, but are more frequently noted in conjunction with adenofibroma, scirrhus, carcinoma, and sarcoma.

CYSTS.—These growths are occasionally met with, and present as

symptom only a localized enlargement, with unmistakable fluctuation.

Cysts are usually due to dilatation of the glandular portion of the lacteal tubes, followed by obliteration of the excretory duct; occasionally the sac develops in the interstices of the gland. In the tubular form a clear or gelatinous serum is exuded; the parenchymatous cysts, however, usually contain a sanguineous fluid. The cystic walls form part of the surrounding tissues, and cannot be peeled off from them without lacerating the latter.

A peculiar type of cystic disease of the breast has been described by Réclus. It consists in the development in the healthy tissue, and in both breasts at once, of a large number of cysts, varying greatly in size from that of a pinhead to a hen's egg, and containing a more or less thick liquid, which may be either quite transparent or dark. Their growth is gradual and causes but little, if any, suffering. They feel like hard subcutaneous masses which cannot be said to fluctuate.

Clinical experience has shown that cysts can assume a malignant type in some instances. As a rule, however, a pure cyst, when left to itself, remains benign, and, when operated upon under strict antiseptic precautions, does not recur.

Cysts are often mistaken for cancer; the diagnostic points are: cysts generally attack both breasts; the youth of the patient, the regular form of a cyst, lack of adherence in the overlying skin, and the presence of liquid determined by aspiration. Cysts may coexist with cancer, but do not give rise to it. The marvelous reports of success among surgeons in curing cancer may depend on the fact that they have frequently

removed only a comparatively harmless cyst. Réclus (*Presse méd.*, June 14, 1911).

Treatment.—A serous cyst should be **aspirated** with a small trocar, this being followed by the **injection of iodine**. If suppuration occurs, or if the cyst is not cured by the injection, it should be opened and **evacuated**. **Excision** may have to be resorted to, but the fact that the walls of the cyst adhere to the adjoining tissues renders this procedure somewhat difficult.

DERMOID CYSTS.—These tumors are rare and may be in the skin or imbedded in the breast tissue proper. These benign cysts clinically never resemble the malignant growth, but may eventually become malignant (Bloodgood). Should the tumor become infected, it resembles an abscess. The cyst is recognized by its distinct wall and characteristic contents upon exploratory incision.

By dissection the cyst is easily separated from the surrounding tissues.

HYDATID CYST.—Hydatid cysts begin as a simple, hard, distinctly circumscribed swelling, freely movable on the subjacent tissues. The growth is slow and may remain stationary for years, never larger than a hen-egg. Should suppuration take place the hydatid membranes and hooklets may be seen with the pus. Axillary glands may or may not become enlarged. The breast becomes painful in the later stages. Suppurating hydatids may be mistaken for an abscess, but aspiration will reveal the true nature of the disease.

Treatment.—The treatment consists of **dissecting out the tumor**; or if much glandular substance has been destroyed, partial or complete **amputation** is preferable.

During the last five years the writer has invariably practised **Warren's method of plastic resection** in all benign growths and those of a questionable nature. The free incision beneath the breast is much better than a smaller incision directly over the tumor. Rodman (*Jour. Amer. Med. Assoc.*, Mar. 18, 1911).

In all doubtful cases the writer introduces a needle. If it is a cyst, **evacuation of the fluid** causes disappearance; if it is a solid growth, it remains. If the fluid is clear he has no doubt of non-malignancy; if bloody, the case is operated on. Shepherd (*Annals of Surg.*, Aug., 1916).

SEMIMALIGNANT TUMORS.

CYSTIC DISEASE, OR CHRONIC CYSTIC MASTITIS.—There is a notable absence of a well-defined tumor. Earlier writers regarded this condition as a distinct disease of its own, but more recently it has become the accepted belief that chronic diffuse mastitis and general cystic disease are one and the same. Whether the termination is by resolution or abscess, a condition of subinvolution exists.

All neoplasms of the breast should be considered malignant until their innocence is proved. The proportion of cancer to other tumors is from 80 to 85 per cent. It is in the relatively simple conditions that seem so clear, chronic or involution mastitis, adenomata, and the several forms of cyst, that the danger lurks, for we may let pass the golden moment when a beginning process, absolutely unrecognizable except for the revelations of the microscope, might have been seized on as a local disease and surely extirpated. Gibson (*Annals of Surg.*, Apr., 1909).

While these growths may themselves be benign, they are believed by some observers to degenerate into a malignant growth in many instances, and by others to occur con-

comitantly with cancer, but the former are doubtless in the right.

Chronic cystic mastitis constitutes 13 per cent. of all breast diseases. Two types occur with equal frequency, those in which the growth is distinctly cystic, and those in which the epithelium of the cyst is hyperplastic. Histologically, the proliferative class is subdivided into those in which the epithelial proliferation occurs in the acini, those showing the presence of distinct papillæ in the cysts, and those characterized by the formation of adenomatous areas. In cases characterized by adenomatous proliferation the tendency toward malignant degeneration is most likely and the carcinoma is usually of the glandular type. The characteristics of these groups are recognizable only on microscopic examination, the cases symptomatically being identical with other forms of the disease. The disease usually occurs in women approaching the menopause, though it is found at an earlier age. It is usually discovered by accident, grows slowly, at times rapidly, and if not diffuse is usually found in the upper outer quadrant of the breast. The affection is at times bilateral, is exceptionally painful, and occasionally tender on palpation. The axillary lymph-nodes may or may not be enlarged, but are not as hard as the glands characteristic of cancer. Speese (*Univ. of Penna. Med. Bull.*, Jan., 1908).

The writer has encountered 14 cases of chronic cystic mastitis in the last three years. A transformation into cancer was evident in 7 of the female cases and in some of the men. Bertels (*Deut. Zeit. f. Chir.*, Sept., 1913).

Cystic disease of the breast unquestionably predisposes to cancer. Microscopic examination in cystic disease of the breast may reveal the cancer in its earliest incipency and thus permit a truly radical cure. Among the 75 cases reported and compared, cancer had developed in

the cystic affection in 29 cases of cystic disease of the breast. Only 3 were found free from cancerous degeneration. Gosset and Masson (*Revue de gynéc.*, vol. xxi, No. 4, 1913).

Report of 218 cases of chronic cystic mastitis operated on at the Mayo clinic. Of these, 11 were in males. Seventy-nine per cent. of the cases occurred in the cancer age. It has a definite relationship to cancer of the breast and in many instances may be considered a precancerous condition. In cases suspicious as to malignancy a radical operation for cancer should be performed. In cases of chronic cystic mastitis that cannot either clinically or pathologically be diagnosed as to malignancy the conservative amputation with removal of the gland-bearing fascia is the operation of choice. E. S. Judd (*Jour. of the Mich. State Med. Soc.*, Jan., 1914).

As described by Syms, chronic cystic mastitis is characterized by irregular, tumor-like masses, which may be felt within the limits of the glands. There may be found one or two well-defined tumors; in fact, there may be present one or more well-developed fibroadenomata. The breast may have a very irregular contour. It is frequently hypersensitive, though actual pain is not a characteristic sign. The skin is not adherent, the nipple is not retracted, or if retracted has no special significance. The breasts seldom attain large size. The condition is often discovered accidentally, though usually the patient has known of the existence of a growth for a long time, but thought it of no importance because of the lack of pain.

Treatment.—The treatment is, of course, governed by the nature of the growth present, but the likelihood of malignancy emphasizes the need of

surgical removal even as a precautionary measure.

We have sufficient evidence, both histological and clinical, to convince us that chronic cystic mastitis, or abnormal involution of the breast, is a frequent forerunner of cancer. It is extremely difficult to determine the transition into cancer by the clinical signs in any given case, but histologically the changes can be readily seen and different parts of the same breast show the changes in progressive ratio. Parker Syms (*Internat. Jour. of Surg.*, May, 1913).

MALIGNANT TUMORS.

SARCOMA.—Pure sarcoma is rarely met with; it is usually associated with other morbid conditions of the mammary tissues; hence the names *adenosarcoma*, *fibrosarcoma*, *myxosarcoma*, *cystosarcoma*, given these growths and which denote their associations. They are no longer regarded as semimalignant growths.

About 16.5 per cent. of mammary tumors were benign and only 2.7 per cent. sarcomas out of a total of 5000 cases analyzed, largely from German clinics. The rarity of sarcoma is in marked contrast with its frequency in other localities. It must be borne in mind, however, that many benign tumors are liable to undergo malignant change, notably the papillary cystadenomas, and they should be regarded from the beginning as potentially malignant. Rodman (*Jour. Amer. Med. Assoc.*, March 18, 1911).

Symptoms.—Clinically sarcoma may assume the type of a rather *circumscribed* tumor, which is immovable, lobulated, and firm. After a time the elevations project somewhat, and may become very soft, and finally become foci of ulceration. The malignant nature of the growth then appears and the axillary glands may become enlarged.

A second form is the *diffuse* sarcoma, which rapidly invades the entire gland, but follows otherwise about the same clinical course as the first variety. In sarcomas associated with soft tumors, such as adenoma or myxoma, the tumor is less hard, and suggests the benign forms with which the sarcomatous type is combined.

Diagnosis.—From cancer of the breast sarcoma is distinguishable by the following characteristics: It does not adhere to the skin, though this may be distended, thin, and even ulcerated, owing to the size of the tumor. The entire gland is not, as a rule, affected and the nipple is not retracted. The axillary lymphatics are seldom enlarged. There is but little pain.

Mammary sarcoma occurs in young adults, whereas cancer rarely appears before the age of 45 years. It is frequently observed in men and in them is usually of traumatic origin. It is often mistaken for an abscess and opened.

Prognosis and Treatment.—Sarcoma is ranked next to cancer as regards malignancy. It may also recur after extirpation, and may become generalized in the viscera. The fact that it does not always do so causes this variety of growth to be classed as semimalignant. It should be **removed**, including the superjacent skin. This is easily accomplished by raising the mass with one hand and including it within two semilunar incisions the tips of which meet. No diseased tissue should be allowed to remain.

Case of sarcoma of the breast in a colored girl 16 years of age. The tumor was removed and after six years there was no evidence of recurrence. Miel (Denver Med. Times, Feb., 1907).

The prognosis after removal of a mammary sarcoma must always be a guarded one, although statistics seem to give more favorable results in excisions of the breast for sarcoma than for carcinoma. Thus, Horner's figures show 76.9 per cent. free of recurrences after two years, and ultimately 61.5 per cent. of total recoveries, but their statistical value depends entirely on whether or not the cases were all true sarcomatous tumors. The spindle-celled variety of tumor is undoubtedly the least malignant. Probably the most important element in prognosis is the rate at which the tumor has grown before operation—the more rapid that has been, the more unfavorable. In fact, clinical experience teaches that the malignancy of some sarcomata exceeds that of the carcinomata, and that early invasion of the axillary glands is an unfavorable feature. Sir George Beatson (Edinburgh Med. Jour., Jan., 1909).

CANCER.

The pathogenesis of cancer itself has been so thoroughly considered in the second volume of the present work by Janeway that a few additional facts concerning its occurrence in the mammary gland need alone be reviewed in the present article.

About 11 per cent. of breast tumors are said to be benign, but non-malignancy is in a much greater proportion in the early stages. The influence of transient trauma has been much disputed, but a history of injury, usually transient in nature, was obtained in 13 per cent. of the malignant breast tumors by the author. J. B. Deaver (Jour. Amer. Med. Assoc., Mar. 15, 1913).

Of 218 cases from the Mayo Clinic, 41.7 per cent. of those over 50 years of age were alive from 5 to 8 years after operation, while only 31.8 per cent. of those under 50 lived a corresponding time. The immediate hospital mortality from operation was less than 0.5 per cent. The prog-

nosis was not affected by the removal of small growths for microscopic diagnosis before the radical operation. Sistrunk and MacCarty (Trans. So. Surg. Assoc.; Jour. Amer. Med. Assoc., Jan. 8, 1921).

Two forms of cancer of the breast are met with, the *scirrhus*, or hard, cancer, in which there is excessive development of fibrous tissue, and the *encephaloid*, or soft, cancer, in which the epithelial elements play the leading rôle.

SCIRRHUS, OR HARD, CARCINOMA.—In this variety the initial symptoms vary with the location of the primary cancerous focus. In deep-seated cancer the gland may become enlarged and hard, but not essentially deformed. The skin adheres closely to the mammary tissues, and the gland itself adheres to the mammary walls. In other cases the breast practically collapses and atrophies and the nipple becomes retracted, constituting the atrophic, or withering, form of scirrhus.

Retraction of the nipple (not undeveloped nipple), or retraction or tethering of the overlying skin, is an important sign of scirrhus, but has been known to occur in chronic abscess, or even in simple sclerosing mastitis. Puckering of the overlying skin may be the only sign of a deeply buried scirrhus growth. In cancer there may be quite hard enlarged glands, but the glands may also be decidedly enlarged in chronic abscess, and particularly so in tuberculous disease. One must clearly recognize the fact, however, that we may not find any enlarged glands in early cancer. Redness and edema of the overlying skin is suggestive of suppurating malignant growth. The hardness of a lump is suggestive of scirrhus, but a very tense cyst may be as hard. C. A. Morton (Bristol Medico-Chir. Jour., June, 1912).

In still another type the cancerous process affects a certain part of the breast only, and thence invades the whole gland by throwing out fibrous bands or strips, which radiate through the organ in all directions. The surface of the breast may then assume various types of irregularity, with promiscuously distributed undulations.

The tumor may be essentially cutaneous at first and subsequently invade the deeper tissues. It then appears in the form of irregularly disseminated *plaques* or hard, superficial areas, which unite and may involve a large portion of the superficial tissue. The skin appears as though tanned, and is hard, rough, thick, and red. This scirrhus transformation may gradually affect the whole anterior portion of the thorax, which thus appears to be topped with a sole-leather-like covering; hence the name "*en cuirasse*" given this type of cancer. Sometimes the disease appears in the form of nodules varying in size from that of a cherry to a millet seed. These nodules are hard and vary greatly in number. They may, however, remain in the same condition a long time if let alone, but frequently ulcerate. If removed they rapidly recur. They are due to penetration of the cancer-cells into the perivascular lymph-spaces of the cutaneous vessels. When scirrhus of the skin follows upon a deep-seated cancer, similar nodules may develop around the edge of the cancerous ulcer. Their appearance indicates a tendency to spread and to become generalized.

Scirrhus, or hard, cancer, when left to itself, transforms the whole breast affected into a stone-like mass. Into this the nipple is more or less

drawn by contraction of the milk-ducts through infiltration of the latter with young cells and subsequent metamorphosis into fibrous tissue. If the cancerous focus is far from the nipple, the latter may only be somewhat distorted through irregular tension of the skin.

Deep or superficial ulceration may occur, which differs greatly from that observed in epithelioma of the breast. The ulcer resembles a crater with irregular, hard, everted edges, and whose base is covered with foul, unhealthy granulations, giving off a thin, offensive discharge. Such ulcers are apt to bleed, and severe hemorrhages may occur. The axillary glands become involved early; but their detection at first requires careful examination. They gradually enlarge, and by pressing upon the surrounding vessels and nerves may give rise to edema of the arm or to neuralgic pains. The entire lymphatic system of the trunk is exposed to contamination; hence the visceral complications often witnessed.

The writer has collected from the literature the reports of 1952 cases of mammary cancer. There was a secondary growth in the opposite breast in a little over 9 per cent. of the cases. Of the abdominal organs, the liver is by far the one most frequently involved. The kidney, however, is least frequently affected. The relative frequency of the involvement of the different organs is often quite unreliable when determined clinically. The figures made from autopsy findings should alone be accepted. In a series of 410 cases with a post-mortem examination the liver was involved in 202 cases and the kidney in 1—a vastly higher percentage. In the 470 cases examined with the microscope the vertebrae were involved 32 times and the

femur was involved 28 times. Ribbert states that bone metastases in females most commonly follow cancer of the breast. J. C. Hubbard (Boston Med. and Surg. Jour., July 4, 1912).

Suffering only becomes serious when the tumor has reached a certain size. Pain of a stinging or burning character is sometimes complained of; involvement of nerves often cause it to be neuralgic and persistent, especially in the shoulder and arm. The ulcerative process, the general toxemia incident upon the presence of the purulent mass, and the mental sufferings of the patient bring on exhaustion, which finally ends in death.

ENCEPHALOID, OR SOFT, CARCINOMA.—The encephaloid variety of mammary cancer, though less often met with than the scirrhus, is nevertheless common. It always starts in the gland itself, and only affects the skin at a later period. Its onset is insidious. It may have existed for some time unperceived by the patient. A hard tumor located in the gland is first noticed; this may be free from surrounding tissues or fixed, according to the time it is detected. It may also present nodules varying in density owing to the presence of cysts and sanguineous infiltration. At first the skin is free and traversed by unusually prominent bluish veins, some of which finally become varicose; spots of redness then appear, the precursors of adhesion of the cancerous mass to the skin. This occurs at an early stage, and is caused by infiltration of the cancerous elements into the tissues. The whole tumor then becomes a reddish, fluctuating mass, which soon degenerates and becomes fungous; it then bleeds easily when

touched, and gives off a foul odor. Burning and shooting pains, which are more severe and appear earlier than in scirrhus cancer, occur, and steadily increase in intensity. Retraction of the nipple also occurs, and engorgement of the lymphatics can be detected at an earlier date.

The ulceration differs essentially from that of scirrhus. Instead of being surrounded with a harder border, forming a crater-like cavity, it assumes the aspect of a large fungous sore. The least touch causes it to bleed, and hemorrhages are much more frequently observed than in scirrhus, but fortunately are arrested with less trouble. Cachexia also appears earlier. All the acute symptoms are aggravated, and complications in remote organs are more frequently observed.

DIAGNOSIS.—The anxiety caused by a growth in this region renders a careful differential diagnosis of unusual importance.

A positive diagnosis of breast cancer is usually too long delayed, as the classical signs generally indicate extensive metastasis. A few cases disseminate extensively without any symptoms. The writer's cases show the fallacy of Billroth's assertion that lancinating pain is an early symptom, though it is common in the later stages. The favorable time for operation is when there is a symptomless, freely movable lump in the breast, but patients are rarely seen at this stage. In his series both malignant and benign tumors occurred most frequently in the upper and outer portions of the gland. Enlarged axillary lymph-nodes do not necessarily mean malignancy; they are found non-malignant with the microscope in 6.5 per cent. Absence of attachment to the pectoral fascia does not indicate non-involvement of the fascia, which, as well as the mus-

cles and intramuscular lymphatics, may be involved before adhesion occurs. Distant metastases are probably accounted for by blood infection. Deaver (Jour. Amer. Med. Assoc., Mar. 15, 1913).

The first question to be determined is whether the tumor be benign or malignant. To determine the exact nature of a tumor at the very onset is often impossible, but this difficulty gradually decreases as time progresses. Still, there are at all times landmarks upon which the surgeon may base a guarded opinion even early.

As a rule, benign tumors occur before the age of 35 or 40, while the malignant growths are more frequently met with after that age. Again, the evolution of the neoplasm is much more rapid in malignant tumors than in the benign. The latter usually remain free or detached, and, if at all superficial, can be rolled under the finger, indicating the absence of adhesions. In malignant tumors, on the contrary, adhesion to all the surrounding tissues becomes at once evident, their limits, even in the beginning, being practically indefinable, while later on the cutaneous and all the underlying tissues become incorporated in the tumor.

The density of the growth and the aspect of the skin also afford a clue. Benign growths are usually soft and elastic when pressed upon, while malignant neoplasms are hard and lumpy. The skin retains its softness and usually rides freely over the benign tumor, while over a malignant one the skin becomes abnormal and assumes a leathery aspect.

In benign growths the nipple usually remains free or merely distorted by the change in shape of the breast.

In cancer it is drawn into the organ and held fast in that position by fibrous bands.

The lymphatic glands of the axilla rarely, if ever, become enlarged in benign growths; if they do at all, the enlargement is slight. In malignant growths they are always more or less enlarged, and steadily increase in size as the disease progresses.

Benign tumors very seldom cause inconvenience to the patient except by their volume and their weight. Malignant tumors, on the other hand, are attended by more or less pain, usually of a lancinating character. The suffering becomes more acute from day to day.

Ulceration sometimes occurs in benign tumors through pressure, but only when the growth is very large. The edges of the ulcerated portion remain thin and free, and there is no fetid or sanious discharge. In cancer, as stated, ulceration is one of the salient features and is characterized by marked foulness. The general health usually remains good in benign tumors. In malignant tumors the patient soon becomes cachectic and shows marked evidence of deterioration. The edema of the arms and the complications alone belong to the malignant types of growth.

A scanty, thin, bloody discharge is suggestive of carcinoma, and thick granular discharges always suggest malignancy. A bloody discharge unless it can be shown to come from an intracystic papilloma should cause the entire removal of the breast. A bloody discharge is now and then seen in connection with abnormal involution and this may also occur together with retraction of the nipple, though no malignancy has yet developed. Rodman (*Jour. Amer. Med. Assoc.*, Mar. 18, 1911).

The only hope of cure in cancer of the breast is a **radical operation**; a large proportion—32.86 per cent.—of patients operated on by the radical method pass the 3 year period, and 23.77 per cent. the five year period. J. H. Jacobson (*Ohio State Med. Jour.*, Sept., 1918).

Sections of female breasts showed that cancer can and does begin in cysts, and that it gives rise to typical microscopic appearances of this mode of origin. The writer advises **removal** of every breast which is obviously clinically cystic, even if only a single cyst is present. G. L. Cheatele (*Brit. Jour. Surg.*, Oct., 1920).

Treatment.—Internal remedies innumerable have been proposed as specifics, but time has in all demonstrated their worthlessness in true cancer.

Even the local methods, topically or hypodermically employed, and which will be described at the end of this article, (see also **CANCER**, Vol. II.) are open to serious objections, and should, therefore, only be resorted to in inoperable cases or where the patient, through fear or for other reasons, will not allow the use of the knife. The surgeon must, therefore, choose between the palliative method, which resolves itself into reducing the patient's sufferings during her gradual progress toward death, and the radical method, which gives her, if the tumor is not too far advanced, a good chance to recover. Especially is this the case since greater freedom has become the rule in the removal not only of cancer of the breast, but of the contaminated glands. Indeed, nowadays few operations for well-developed cancer can be considered radical unless removal of the primary growth is accompanied by prophylactic extirpation of its tributary lymphatic areas.

At Hochenegg's clinic, 606 cases of mammary cancer gave rise to permanent cures in from 12.5 per cent. before 1903 to 24.64 per cent. Greater attention is being paid to removal of extensive areas of skin and to evacuation of the supraclavicular fossa. Cures were realized in some cases in which the supraclavicular glands were already involved. Finsterer (Deut. Zeit. f. Chir., July, 1907).

Out of 142 patients on whom the writer operated for mammary cancer from sixteen to three years ago, 44 patients have been permanently cured. The size of the tumor does not affect the outcome decisively, but in none of the permanently cured patients had the tumor grown to the skin and tissues below. A family tendency was apparently evident, and in these cases the cancer seemed to be especially malignant. Good results can be counted on only in those cases with slow growth in which the tumor is no larger than a plum, and is still confined to the gland. Steinthal (Archiv f. klin. Chir., Bd. lxxxvi, Nu. 3, 1908).

Nearly 50 per cent. of the patients are allowed to go untreated for a whole year before seeking operative relief. *Per contra*, only 8 per cent. apply during the first month. The writer urges early application to the practitioner whenever a breast tumor appears. If cancer is thus early found, the modern radical operation can be carried out with the best prospect of saving life. A. Primrose (Amer. Jour. Med. Sci., Jan., 1913).

Review of the results of 609 cases of cancer of the breast operated upon at the Mayo clinic from 1902 to 1912. Of these cases 607 were females and 2 males. Of the 609 cases the authors were able to trace and have accurate knowledge of 514. Of these, 248 were known to be alive from two years to eleven years and four months after operation. Thirty-seven of these were known to have recurrences. There was a percentage of 32.5 alive without recurrences

more than ten years; 39.8 alive more than five years, and 44.7 living more than three years.

Excision of the tumor or a part of the breast, followed by a radical operation within a few days or weeks, does not always mean a bad prognosis. In 1 case the radical operation was not performed until seventeen days after removal of a breast for supposed mastitis, and this patient was living without signs of recurrence seven years and nine months after operation; in another (a specimen had been removed one week before the patient came to the clinic) a radical operation was done and the patient was alive and free from recurrence over six years after operation. Edema in the tissues is considered a contraindication to operation. Cancer in the lactating breast proved most unfavorable.

On the whole, the functional results were very good, most of the patients reporting that their arms were all right. Pain in the arm was usually complained of shortly after operation, but in most cases it disappeared within two weeks. Swelling and edema were occasionally marked, either primarily due to thorough removal of the lymphatics, and persisting until collateral circulation in the lymphatics was established, or as a secondary edema several months or years after operation, and due to a recurrence in the remaining lymphatics. Metastasis may occur many years after the operation, though in the great majority of instances it will appear in the first few years if at all. The difference between the percentage of patients living more than three to five and ten years was not as great as might have been expected; this is because most patients who die of the disease die within the first three or at least the first five years. Living five years without recurrence is an indication of but slight trouble in the future.

Comparing the results with those of former years, the authors feel that

the results are improving. The improvement seems due to the fact that patients are coming earlier rather than to any improvement or change in the technique. E. S. Judd and W. E. Sistrunk (Surg., Gynec., and Obst., Mar., 1914).

The results of the *older* operations, *i.e.*, prior to earlier and more radical removal, give the following percentages of local recurrences: Billroth, 85; Czerny, 62; Fischer, 75; Gussenbauer, 64; Volkmann, 59, and Gross, 68; by present-day methods, in which *timely* and *thorough* eradication of the growth is the rule, the recurrences may be as low as 20 per cent.

Report of each of 200 cases in which over half the left breast was involved, probably the first complete series of the kind on record. Good results were obtained when the tumor was of slow growth and not larger than a plum, the skin still movable. In this group over 80 per cent. of the patients were permanently cured, while less than 30 per cent. were cured in the group in which the tumor had begun to grow, possibly after a stationary period, and the skin was adherent and several glands in the axilla were palpable, and where there was a family history of cancer. Höring (Beiträge z. klin. Chir., Dec., 1908).

Where the average case, *i.e.*, cases in the various operable stages of the disease, are thoroughly treated surgically, the chances of permanent recovery have also been greatly enhanced, even when late recurrences are taken into account.

As the result of extensive statistical study by the writer, in numerous clinics more than one-quarter of the patients ultimately suffer from late recurrence. In 2107 collected cases of operated mammary carcinoma on record there was late recurrence in 2.3 per cent. Recur-

rence occurs in 29.6 per cent. of those remaining well over three years. Wunderli has observed the same fact in 33 per cent.; Poulsen in 18.1 per cent.; Hirsch in 29.3 per cent.; Schroeder in 19.7 per cent., while Steinthal noted that out of 99 patients who remained well for three years there was recurrence in 63. The largest number of late recurrences occur in the first ten years. There are about 15 recorded cases in which there was late recurrence in the second and three in the third decennium after operation. Verneuil records the latest recurrence—viz: thirty years. Bircher (Centralbl. f. Chir., June 29, 1907).

As to the actual number of cures obtained by the *older* methods, Billroth (1876) claimed 4.7 per cent. of cures; Küser (1881) 21 per cent.; Koenig, 23, and Bergmann, 39. Gradually as the malignant growths and their extensions were removed with increasing thoroughness, however, we find the average of Rötter, Helferich, and Watson Cheyne's cases (1896) to reach 49.5 per cent. Watson Cheyne found that, while in a collection of 1491 cases, obtained from various sources and operated upon by older methods, 14 per cent. had been cured, 11 operated by newer methods had yielded 34 per cent. of cures. Bloodgood, 1913 and 1914, from a series of cases at the Johns Hopkins Hospital, reports from adenocarcinoma, all cases, 76 per cent. of cures. Early cases, when the lump in the breasts was of such short duration that none of the signs of cancer were present, 100 per cent. of cures; late cases, 64 per cent. of cures.

In the more malignant forms of cancer of the breast—medullary and scirrhus—the results are even more striking: All cases, cured, 36 per cent.

Early cases cured, 85 per cent. Late cases cured, 33 per cent. The improvement from 35 per cent. in 1908 to 42 per cent. in 1913 is entirely due to increase in the number of early cases, because in these five years there has been no improvement in the surgery of the mammary gland. In the Mayo clinic from 1902 to 1912 (609 cases) the authors were able to trace 514 cases and 39.8 per cent. were known to be alive for more than five years, with the probability of a higher percentage of cures. Here, again, the improvement is regarded as due not to any betterment in the surgical technique, but to the fact that the patients are coming early instead of late.

Unfortunately, many cases are not seen sufficiently early to warrant operative procedures. Glandular involvement has often been allowed to extend to the axilla, when the chances of a successful issue are reduced. These become inoperable cases, however, when scattered cancerous tubercles are met with over large areas, indicating extensive infiltration of the skin,—i.e., undefined limits; or, when the cancer has assumed the *en cuirasse* type, and has so progressed as to involve a large part of the surface. They become especially so when the internal viscera—the liver, the lungs, etc.—show indications of metastasis. Great and persistent edema of the arm is considered as a contraindication, but it should not stand as such in all cases.

A class of cases in which forbearance should be the rule is that occurring in old women, in whom a cancerous growth may, without giving rise to serious suffering, extend over several years—ten to twenty some-

times. An operation in such cases would soon be followed by recurrence and earlier death.

The most important contraindication to operation is distant metastasis to the internal organs. A second contraindication is the absolute fixation of the tumor to the thorax, though operation has been done on a few of such cases. The third contraindication is the spreading of the cancer in lentil-like masses over the chest or cancer *en cuirasse*. However, the author's series of 520 cases presents 9 exceptions to this. In 1 of these cases the woman is still living, seven years after the operation, and does her own housework. The general condition of the patient, the age, and the presence of other diseases must be considered, the latter only in reference to the degree of development. The final contraindication is furnished by the presence of involvement of the supraclavicular lymph-glands. This, however, is a much debated point. Finsterer (Deut. Zeit. f. Chir., Bd. 89, H. 1-4, 1908).

Radical operation should be excluded (1) when the growth is fixed to the thorax, (2) when the skin is extensively involved, (3) when the axillary vessels or nerves are implicated, and (4) when there are deposits in the viscera or bones. In palliative operations the skin flaps should be so cut that the wound may heal by first intention. English (Pract., Sept., 1908).

Encephaloid growths occurring in young women seldom warrant operative procedures when at all advanced. Their evolution is extremely rapid in such cases, and excision is almost always followed by recurrence.

Characteristics of benign growths: Occur at any age, often in the young. Slowness of growth. Encapsulated and not infiltrating. Mobile on fascia and under the skin. Absence of glandular enlargement. Usually painless

except in neuralgia. Most frequent in nullipara. No retraction of nipple.

Characteristics of malignant growths: Occur usually after the age of 30. Grow slowly and constantly if carcinoma; rapidly and spasmodically if sarcoma. Carcinoma not encapsulated and soon infiltrated; sarcoma is encapsulated at first and later infiltrates. Early attachment to the skin and fascia. Early glandular involvement. Pain not an early but late symptom. Usually occur in women who have borne children. Retraction of the nipple. An irregular outline and induration gradually merging into surrounding tissue is characteristic of scirrhus. Sherrill (*Internat. Jour of Surg.*, vol. xxx, p. 226, 1917).

Barring the above-mentioned features, **extirpation** is indicated in every case. Many prominent surgeons, indeed, recommend the removal of all benign growths, since they often become the foci for the development of malignant neoplasms. Even when relapses occur successively, the operation prolongs life, tranquillizes the patient, and greatly decreases her sufferings. When in addition the increasing proportion of cures afforded by modern thoroughness and antiseptic methods is considered, the duty of the medical attendant becomes imperative.

Out of 582 operative cases of mammary cancer there was at least 8 per cent. difference in the mortality between the figures for a 3-year interval and a 5-year interval. Only 30.6 per cent. were still living 5 years after the operation. A marked change for the better appeared in the statistics from 1900 on. Systematic postoperative **X-raying** seems to further improve results. Of women operated in 1900-1914, over 42 per cent. are still living. The age between 40 and 50 offers the best chances for survival. Deelman (*Nederlandsch Tijdsch. v. Geneesk.*, Aug. 30, 1919).

The prohibitive features enumerated having been eliminated by a careful examination, the supraclavicular spaces and axillæ should be carefully examined for enlarged glands. When enlarged supraclavicular or axillary glands are detected their influence upon the surrounding tissues is a good gauge as to their size. The presence of pain, slight edema, stiffness, etc., should be carefully looked into, and, if none of these are complained of or detected, the chances that the glandular involvement is slight are very great. Some surgeons recommend an exploratory incision under anesthesia to ascertain that the glandular involvement before operating is not excessive. This is unnecessary, since the need of such a step proves that the case is an operable one.

An early operation, in breast cancer without glandular involvement, will cure in 80 per cent. of all cases. Infection of the nearest axillary nodes gives a lasting result in only 25 per cent. of such cases. The three most important things to consider in the case of a tumor of the breast are: first, age of the patient; second, location of the growth; third, whether it is adherent to the surrounding parts. An involution mastitis, the condition most difficult to differentiate from carcinoma, is also likely to occur about the menopause. The site of the tumor is perhaps more important than the age of the patient. While cancer may appear anywhere on the breast, it is more frequently seen in the axillary than the sternal half of the gland and in the upper than the lower quadrant. Next in frequency the part just behind the areola is involved. Benign tumors and sarcoma are more frequently seen in the sternal half, the upper and inner quadrant especially. The adhesions of the tumor are even more significant. A tumor that is freely movable under the skin and

is as certainly not adherent to the skin is not cancerous. But anything like adhesions causing dimpling or nipple retractions is of bad significance. Asymmetry observed when both breasts are fully exposed and moved in all directions is a valuable sign. There are other points of less importance, such as race and fertility or infertility of the host, which if they all point the same way have a confirmatory value. The influence of heredity should not be ignored, neither should it be overestimated. W. L. Rodman (Jour. Amer. Med. Assoc., May 22, 1909).

Operation.—The most promising procedure is that of Halsted, who contends that the pectoralis major muscle entire, except its clavicular portion, should be excised in every case of cancer of the breast, because the operator is enabled thereby to remove in one piece all of the suspected tissues. J. Collins Warren also emphasized the importance of thorough removal of all suspicious tissues, including a large margin of the cutaneous covering of the breast, a careful deflection of the edges of the wound, removal of the subcutaneous fat for a considerable distance around the mammary gland, the removal of the pectoral muscles, and a minute and painstaking dissection around the sheath of the axillary vessels.

The breast should first be carefully cleansed and asepticated as far as possible and the axilla shaved and treated in the same manner. The incision is then begun at the anterior axillary fold, and, descending as an ellipse embracing the whole gland, is then brought back to the starting point. The skin and fat of the regions traversed should be penetrated down to the muscular tissues beneath, the organ being then detached from below

upward, *i.e.*, progressing toward the axilla.

The supraclavicular region is almost invariably cleansed out by Halsted at this stage, and he found that removal of the supraclavicular fat and lymphatics is best done from within outward and from below upward. The subclavian vein being the starting point in the dissection of both the infraclavicular and supraclavicular regions, it is unnecessary to remove the clavicle and useless to divide it. By elevating the shoulder the clavicle can be raised an inch or more away from the first rib. The fingers can be passed from the supraclavicular to the infraclavicular and to the subscapular regions under the clavicle, and any fat in the latter region, near the internal or the posterior border of the scapula between the serratus magnus and subscapular muscles, which could not be drawn out through the neck, removed. To excise the supraclavicular tissues a vertical incision is used parallel with the sternocleidomastoid muscle near its posterior border; a few of the posterior fibers of this muscle are divided and the junction of the internal jugular and subclavian veins is exposed. At the angle of junction of these veins the dissection is begun. The omohyoid is divided at its tendinous part, the two bellies of this muscle being drawn out of the way. The supraclavicular fossa is cleansed out or stripped, with very few exceptions, at the primary operation. The rule should be to operate on the neck in every case. The minor as well as the major pectoral muscle is removed, the insertion of the major, and then its origin and the origin of the minor, being divided before the sub-

clavian vein is exposed, first at its inner part, and the axilla stripped of its contents and its anterior wall at one time from within outward and from above downward. The mass to be excised must always be circumscribed with a circular or an oval incision, and an additional cut made to expose axillary and jugular veins. The operation is performed in an absolutely bloodless manner. In all cases the wound is grafted immediately; this is done by cutting grafts from the patient's thigh as large as or larger than one's hand. A single one of these large grafts may be enough to cover the raw surface. In cutting a graft of this kind the skin is made tense by a board which the operator slides along the thigh just in front of a large amputating knife or catlin. The graft is spread, raw side up, on a piece of rubber tissue, and from the latter is readily transferred to the breast wound. It is finally covered with silver foil and tissue-paper, and need not be looked at again for two or more weeks.

The incision down the arm, made shorter and shorter, was finally abandoned. The vertical cut to the clavicle is made as short as feasible, and when considerable skin has been removed above is omitted. Not infrequently the only incision of the skin is the circular one surrounding the tumor, but, as a rule, the one or the other of the vertical incisions has been made. By means of the two vertical incisions, one above and one below, the dissection of the axilla is, of course, facilitated. Thus the triangular flap has been definitely abolished. The skin of the outer flap between the two vertical incisions is utilized primarily to cover completely, without any tension whatever, and redundantly the vessels of the axilla. The edge of this flap is

stitched by interrupted, buried sutures of very fine silk to the fascia just below the first rib in such way that the skin partly envelops the large vessels. Then, along the entire circumference of the wound, the free edge of the skin is sutured to the underlying structures of the chest wall, the wound being made as small as desirable in the process of closure, and tension on the upper or axillary part of the outer flap assiduously avoided. Considerable traction may, however, be exercised on the mesial flap and on the lower portion of the outer flap. Whatever the size and shape of the grafted defect, it should usually extend to the top of the axillary fornix. Thus the thoracic or inner wall of the apex of the axilla is always lined with skin-grafts. The advantages of skin-grafts are that an almost unlimited amount of skin may be removed, and from his experience the results have been better the larger the areas of skin taken away, and the wider berth given the tumor. Skin-grafts present a definite obstacle to the spreading of cancer metastasis, as the growth does not tend as much to invade the grafted area. W. S. Halsted (Jour. Amer. Med. Assoc., Feb. 8, 1913).

Experience has convinced the writer that in many instances the sole reason for recurrence is insufficient removal of skin, the surgeon being too much preoccupied, as a rule, in leaving enough skin to render possible immediate union of the wound margins. By using a flap consisting of skin from the back, as well as large sections of the latissimus dorsi and teres major, free excision of skin is permitted, viability and high resisting power of the covering of the wound is insured, and the formation of a linear scar in the axilla, with consequent limitation of movement and compression of veins, is avoided. The writer advocates the use of his method of closure in all cases of breast cancer in which a radical operation is not contra-

indicated. Tansini (*Presse méd.*, Jan. 3, 1914).

In recent years there seems to be a diminution in the ratio of cancer as compared with benign tumors of the breast. Bloodgood in 1916, held that the relative proportion of benign lesions in the breast is steadily changing, and the percentage of benign lesions is on the increase. He is of the opinion that this change is associated with the shorter duration of the disease and that women are seeking advice earlier. The medical profession itself is also concerned.

Bloodgood's observations were based on the study of 1577 cases recorded in the surgical pathological laboratory at the Johns Hopkins Hospital. He gives the following percentages of benign lesions:

From 1889 to 1900	32
From 1900 to 1910	41
From 1910 to 1913	47
From 1913 to 1915	59

Bloodgood also urged that inoperable cases are distinctly on the decrease. His views have also been expressed by Bevan and others. They also represent the writer's own experience in the matter. In 74 breast operations he found 26 to be benign. J. H. Jacobson (*Ohio State Med. Jour.*, Sept., 1918).

When such radical measures are not required, and a simpler operation is warranted by the limits of the tumor, the following procedure may suffice: The breast is carefully aseptized by washing, and bathed with a mercury bichloride solution, and the axilla is shaved and treated in the same manner. An incision is then made, also from the axilla, but anterior to it, extending downward and around the tumor, the latter being included in the ellipse formed, and meeting the starting point. Even if the growth be exceedingly small, a wide margin should be removed with all suspected tissue.

The knife should penetrate clear down to the muscular aponeurosis, from which the mass can easily be detached, but if the aponeurosis is adherent it must be removed. If any muscular fibers also show adhesions, the Halsted operation should be resorted to. The vessels should be rapidly caught to avoid hemorrhage as the case proceeds.

Examination of the axillary ganglia is warranted in all cases, and their careful dissection is always indicated when there is the least suspicion that they may be involved. They are unmistakably so in over 60 per cent. of cases.

The writer's method of operating has changed with his experience, tending all the time to become more radical, and he has definitely abandoned all flap operations. The radical procedure is just as safe and he believes safer than incomplete operation, the operative mortality being exceedingly small. There is but one treatment and that is operation, the earlier and more radical the better. He objects to the plan adopted by most surgeons of working from the sternum to the axilla and enumerates the advantages of first attacking the axilla itself and working inward: First, the axilla may be so hopelessly involved as to render removal of the tumor worse than useless. Second, the blood-vessels can be reached and tied at their origin, lessening hemorrhage and shock. Third, the axillary space is dissected from above downward, instead of from below upward, which is better from both a surgical and pathological point of view. Fourth, one avoids largely, if not wholly, the great danger of expressing and distributing cancer cells. Fifth, a dissection *en masse* is sometimes made impossible if the work is begun at the sternum, as the heavy mass may pull on and break the axillary tail. Sixth, the functional use of the arm

will be better, for the reason that by beginning at the axilla greater precision is assured. It is of the greatest importance not to extend the incision onto the arm, as the resulting cicatrix often restricts the limb in its future movements. The successive steps of the operation as he performs it are illustrated. One of the figures shows drainage-tube inserted, but he does not now consider this necessary. Rodman (Jour. Amer. Med. Assoc., May 22, 1909).

The wound is then to be carefully washed with a bichloride solution, after carefully arresting all the bleeding vessels. The antiseptic solutions used should be lukewarm, to prevent chill, the operation being rapidly performed in a warm room for the same reason. The two edges of the wound should then be sutured, after having placed a drain at each end of the wound. The whole may then be dusted with an antiseptic powder or a dry sterile dressing applied and covered with a thick layer of antiseptic absorbent cotton, held in position by adhesive strips or a broad bandage tightly fastened around the chest. When antiseptic precautions have been carefully carried out, union takes place at once. The dressing should not be removed until the third or fourth day, to remove the drains and sutures. These should be replaced by strips of linen impregnated with iodoform collodion.

When the operation has been done thoroughly with removal of all glands, of the tumor wide of its borders, and of the aponeurosis and the pectoral muscles when the tumor is adherent, the use of **radiotherapy** on the resultant scar serves to sterilize all the remaining tissues, and to prevent recurrence. In this field it is most beneficial. E. Villard and E. Mouriquand (Lyon méd., May 19, 1907).

Treatment of Inoperable Cases.—

When the growth cannot be removed, palliative measures must be adopted. The organ must be relieved of all pressure, and the movements of the corresponding arm restricted as much as possible. The use of **morphine** and **atropine** hypodermically in such cases is fully warranted, the object being to curtail suffering, even if very large doses have gradually to be reached. Locally, **boric acid**, directed over the growth, and a solution of **acetate of lead**, 20 grains (1.3 Gm.) to the ounce (30 c.c.), sprayed over it, are useful procedures. Local applications of solutions of the **extract of opium** or **belladonna** sometimes quiet the suffering. **Chloretone** may be used for the same purpose.

Bernart recommends, as a curative measure in inoperable cases, interstitial injections of a solution of **salicylic acid**, 15 minims to 1 dram (1 to 4 c.c.) of a 6 per cent. **alcoholic solution** being used after strict antisepsis. From 10 to 15 injections are said to produce considerable alleviation.

Hasse, of Nordhausen, has used **injections of alcohol** for more than twenty years in the treatment of inoperable cancer, and 4 cases of this kind in his practice are now cured. He uses the same method in cancer of the breast, and believes that cure could be effected in these cases by surrounding the breast with cicatricial tissue by means of alcohol injections. It is preferable, however, to extirpate the breast and treat recurrences by the injections. In this manner he obtained radical cure in a case declared inoperable by Volkmann. Vulliet, of Geneva; Kuh, of Chicago; Young, of Bloomington, and others have also

obtained good results from this method. Hassel used alcohol diluted one-half or even more with very sensitive patients, having found it less painful, while equally effective. One, or at most two, injections are made at a time, drawing the breast out and inserting the needle in such a manner as to cause the alcohol to penetrate into the retromammary cellular tissue beyond the middle of the gland. The contents of the syringe should flow out gradually on gentle pressure of the piston. If there is resistance it should be withdrawn a little and the point reinserted sidewise in another direction. In this way the retromammary space is filled with the alcohol, 4 to 10 c.c. (1 to 2½ fluidrams) for small tumors and 10 to 20 c.c. (2½ to 5 fluidrams) for larger ones. One must be careful to keep well in the space behind the tumor. After the needle is first introduced it should be withdrawn to see if any blood flows out of the needle-hole, showing that the needle has penetrated a blood-vessel. If it has, the syringe must be cleansed and inserted in another place. The injections are made once or twice a week at first, and then later once in two or three weeks. These injections are, unfortunately, rather painful.

The local use of **zinc chloride**, after devitalizing the sensitive tissues with potassium hydrate, has recently (1918) been revamped with success by C. W. Strobell. (See also **CANCER**, Vol. II.)

Another method which has afforded encouraging results is the use of the **Röntgen rays**. This and other methods of treatment are reviewed in the article on **CANCER**, in Volume II.

Occasionally one will see some remarkable instances of advanced dis-

ease yielding to the **X-rays**. The best results are to be found by prompt and energetic treatment. It is difficult to state the actual worth of the X-ray immediately after a primary operation as a prophylactic. Newcomet (*Penna. Med. Jour.*, Nov., 1909).

The application of the **Röntgen rays** will at times cause a disappearance of both small and extensive areas of both recurrent and metastatic carcinoma; the disease can at times be made to disappear when it covers the greater portion of the chest. In at least one case there seemed to be produced some constitutional condition which led to the rapid disappearance of carcinomatous tissue that had not even been exposed to the rays. The additional administration of **thyroid gland** in small doses, as first recommended by Sajous in 1907, seems to aid materially in cure of the disease. Pfahler (*Surg., Gynec., and Obstet.*, Jan., 1914).

Direct application of **radium** has been praised by a number of authors, but for superficial neoplasms. It is being generally recognized, however, that the **X-rays** give better results, on the whole, while entailing a very small outlay as compared with the high cost of radium.

We should not overestimate the value of **radium**; its field is in superficial and inoperable cases and as an adjuvant to operation. Alevoli (*Riforma Medica*, Jan. 29, 1921).

TUBERCULOSIS OF THE BREAST.

There are two characteristic varieties of mammary tuberculosis: the *disseminated nodular* form and the *confluent*.

The *nodular* variety is characterized by the development of single or multiple hard nodules, only slightly painful and at first non-adherent to the skin. The process is exceedingly

chronic, and only after the lapse of several years do the nodules break down and form suppurating fistulæ.

Tuberculosis of the male breast presents at first as a nodule of rather firm consistence, freely movable and situated usually in the upper and outer quadrant. It may be painful, while in some cases pain is entirely absent until a concomitant inflammatory condition ensues. Pain may also be complained of in the arm of the affected side. The growth may remain small for weeks, months, or even years (Scudder's case, five years), when caseation and softening occur with suppuration and the formation of one or several sinuses, the main characteristic of which seems to be a tendency to persist. Resseguie (Albany Med. Annals, Sept., 1909).

The *confluent* variety is characterized by a more acute onset, greater pain, and rapid enlargement of the breast. It is more common than the nodular variety. Retraction of the nipple has been reported in 2 cases. If the disease extends to the axillary glands, it pursues a much more rapid course than in the mammary gland. Occasionally the tuberculous process leads to the formation of a cold abscess, but this is rare, and never occurs before puberty.

SYMPTOMS.—The symptoms of tuberculous mastitis are pain and tumor. The tumor may consist of one or more nodules, firm, hard, and freely movable with the gland. The skin may be freely movable over the growth, but frequently is attached. The nipple may or may not be retracted, and occasionally the entire breast becomes involved in one large, nodular, unyielding, brawny mass. The diagnosis is usually difficult, and is most important when the differentiation between tuberculosis and car-

cinoma is imperative. Under certain conditions it is impossible to distinguish them clinically. The infallible means of differentiation are the microscope and bacteriological culture. The axillary lymphatics are enlarged in three-fourths of all secondary cases; in other instances axillary involvement may be apparently absent; occasionally cervical glands are also infected.

Tuberculosis must, as a rule, be differentiated from carcinoma. The mere presence of a hard nodule speaks for either condition. The age is, as a rule, rather advanced in both cases. When fistulæ are present, especially if tuberculosis is elsewhere to be found, a fairly certain diagnosis may be made. The most certain method is the inoculation of animals with the fluid obtained from the open lesions. E. Braendle (Beiträge z. klin. Chir., Bd. 1; Surg., Gynec., and Obstet., Dec., 1906).

ETIOLOGY.—Of the cases of tuberculosis of the mammary gland, 89.6 per cent. occur in females. The disease is most common between the ages of 20 and 35. Mammary tuberculosis may be primary, depending on infection through the milk-ducts or fissured nipples, or secondary, the disease extending from contagious foci in the chest, but extension from surrounding structures is the commoner method.

TREATMENT.—The treatment of primary mammary tuberculosis consists in **complete removal of the breast and axillary glands**. In the rare cases of *cold abscesses* these may be **aspirated** and **iodoform emulsion** injected.

The entire breast, as well as the axillary glands of the diseased side, should be removed. Only in a few cases, where single circumscribed nodules are present, may a partial

extirpation be done. In 10 of the writer's cases a complete **amputation** was done, the patients being able to go home in eight to fourteen days. E. Braendle (Beiträge z. klin. Chir., Bd. 1; Surg., Gynec., and Obstet., Dec., 1906).

While **excision of the breast** and **cleansing of the axilla** is the treatment of choice in a large number of cases of tuberculosis of the breast, there are also cases with superficial and subcutaneous localization, but no lymphatic reaction, in which evacuation by **aspiration** and injection of a modifying fluid, or else cauterization with the **thermocautery**, ought to be used, before taking up the more radical operation of excision of the breast. St. Jacques (Med. Rec., Feb. 27, 1909).

Operative treatment almost promises permanent cure in primary cases. In secondary forms prognosis depends entirely upon activity, location, and extent of the primary focus. In future the writer would advise **excision** of a tuberculous mass in the breast of a young woman, with exploration of the axilla for palpable lymph-nodes. In older women simple **amputation, with excision of axillary nodes**, is the best method. **Tuberculin** should be given, as it may perhaps aid nature in overcoming any small focus which might escape the knife. Conservatism is expressed rather in limiting the excision than in discarding operation. J. B. Deaver (Amer. Jour. Med. Sci., Feb., 1914).

SYPHILITIC TUMORS.

Gummata of the breast are not, according to Bissell, as rare as the authorities would lead us to infer, and such late syphilitic lesions can be quite easily differentiated by careful diagnosis. Many breasts sacrificed in the belief that they were cancerous could have been saved by the proper diagnosis. In case of doubt an attempt should be made by the quick

method of treatment to exclude absolutely the possibility of the tumor being syphilitic.

Gummatous tumors develop slowly and painlessly; they ulcerate and discharge much earlier than cancerous nodules; they are free from nodules early in their course; the nipple, as a rule, is not retracted, and the lymph-glands near may not be enlarged.

TREATMENT.—The best treatment is by means of **injection of the arseniosalicylate of mercury**, $\frac{1}{4}$ grain (0.016 Gm.) of which is given every third day until the tumor begins to disappear, combined, if it be needful, with the internal administration of **iodide of potassium**.

LACTATION, DISORDERS OF.

AGALACTIA.—Absence of the mammary secretion after parturition. The term is generally understood as meaning defective lactation, especially as to quantity.

Symptoms.—Absence of the mammary secretion after labor is rarely observed. The appearance of milk may be delayed days and even weeks, but evidence of functional activity usually appears, although frequently the quantity secreted is insufficient or the quality of the milk is not of a character to afford sufficient or proper nourishment to the infant.

Deficiency of secretion may occur from the start and continue throughout the entire period of lactation, or it may be normal in amount at first and gradually diminish.

Etiology.—Heredity is a prominent factor in case of true agalactia. Puech has reported the case of a woman who had given birth to 13 children, but whose breasts, though normal, had never yielded milk. Her

mother, who had given birth to 23 children, had likewise been absolutely sterile as regards the secretion of milk.

General ill health in which anemia plays the leading rôle is the most frequent cause of retarded, defective, or imperfect lactation. Lack of confidence, on the part of the mother, of her ability to nurse; excitement, fatigue, highly spiced food, overfeeding, and insufficient sleep may be mentioned as the most frequent auxiliary factors.

Injudicious dressing whereby the mammae are compressed, the pressure interfering with their circulation and proper nutrition, is a frequent cause of deficient lactation. Advanced age, especially in women who have suffered frequently from miscarriages, may also be included among the etiological factors. The habit of weaning early or avoiding lactation tends to cause atrophy of the breasts and to repress the lacteal secretion.

Prolonged suckling, specific affections, and iodide of potassium are also considered as causes of mammary atrophy, and, therefore, of deficient lactation.

Intercurrent affections, especially when acute, frequently arrest the flow of milk. High fever, when temporary, usually causes diminution of the secretion for the time being, and it may act as the primary factor of gradual cessation.

Pathology.—When there is total absence of mammary secretion, both breasts are usually affected. When the secretion is only defective, the involvement of the glands in the pathogenic process, local or general, is usually unequal, one mamma being less productive than the other. Large

breasts, owing to the quantity of adipose tissue present, are more likely to be agalactic than the smaller and thinner ones. The ducts and glands are usually found deficient in number and size, while the adipose tissue or the fibrous stroma is unduly abundant.

Treatment.—The first indication is carefully to inquire into the cause of the condition. In the majority of cases there is general deficiency in the performance of metabolic processes, due to general physical apathy. The patient should, therefore, be provided with **nutritious food** and appropriate tonics, especially **strychnin** and **hypophysis sicca**, both of which are peculiarly effective in these cases.

The bowels should be regulated by proper **dieting** and **massage** or **exercise** rather than by laxatives, and it is highly desirable that there should be at night uninterrupted sleep for six hours for mother and child.

Galactagogues are valueless in the majority of cases, most of them exerting practically no influence upon the gland. Occasionally a slight stimulating effect may be noted, but this lasts only a short time, and the organ soon lapses into its former torpor.

Beer, ale, porter, and other malt liquors, especially alcoholic beverages, are more hurtful than beneficial, and what improvement may show itself is due mainly to the confidence in the beverage taken, through the agency of autosuggestion. The quantity of milk may be increased, but its quality is compromised, especially when poor beer is consumed by the mother. It encourages the production of fat at the expense of the casein or milk-sugar. **Pure malt** may be substituted with great advantage.

Probably the most satisfactory among the galactagogues is **jaborandi**. The fluidextract or the tincture may be given in $\frac{1}{2}$ -fluidram (2 c.c.) doses. The active perspiration and salivation produced are objectionable, however, while the effects of the remedy are not lasting.

Castor-oil leaves have always borne considerable reputation. A **decoction** is made by boiling well a handful of them in 3 to 4 quarts of pure water. The breasts are bathed with this decoction for fifteen to twenty minutes. Part of the boiled leaves is then thinly spread over the breast and allowed to remain until all moisture has been removed from them by evaporation, and probably, in some measure, by absorption. The procedure is repeated at short intervals until the milk flows upon suction by the child, which it usually does in the course of a few hours (Routh).

Galega is credited with galactagogue properties, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of the dried leaves or, better, the aqueous extract being given daily.

Electricity sometimes proves effective. A *mild* current (3 to 5 milliamperes) is passed every 2 or 3 hours through each breast after carefully wetting the sponges in salt-water and applying them on each side of the gland.

In cases of recent delivery in which the supply of milk is quickly diminished, the writer injects 1 c.c. (16 minims) of the **mother's own milk** subcutaneously, under strict asepsis. This is repeated in 2 days, and, if necessary, in 5 days again. Results are certain. C. H. Duncan (N. Y. Med. Jour., Jan. 6, 1917).

Artificial suction with the **breast-pump** and **massage** are greatly used. **Thyroid gland** is often helpful.

As to the **diet**, it should be as generous as the patient can digest. There is little to be gained by the common practice of prescribing 2 or 3 extra meals a day. A little broth or a glass of malted milk or plain milk between meals and at bedtime, however, is advantageous. The milk supply as well as the general health of the woman will depend more upon what she digests and assimilates than upon the amount of food taken into the stomach. Three daily meals, with, at most, the additional liquid stated, will generally be better than 5 or 6 meals. The difficulty in digesting milk, of which many patients complain, is, for the most part, imaginary. If taken as a part of the meal and not in addition to it, it will, as a rule, be well borne. Frequently patients who cannot use cold milk can take it hot without difficulty.

The secretion of milk is said to be greatly diminished by fatty food. A vegetable diet reduces the proportion of butter and casein and diminishes the sugar. A meat diet has the opposite effect. Systematic nursing with strict observance of stated intervals is essential for its influence upon both the quantity and quality of the milk secretion (Charles Jewett). Lobster, when available, is probably one of the greatest milk producers in the dietary.

POLYGALACTIA.—Polygalactia, or excessive secretion of milk, cannot be considered a pathological condition, except when it is exhausting the strength of the patient or when the profuse production of milk continues long after lactation has been suspended. The normal production in health approximates 3 pints in the twenty-four hours. Instances have been reported in which as much

as 7 quarts were secreted daily (de Mussy). It is evident that such a degree of hypersecretion need not be reached before emaciation, anemia, and even hectic symptoms appear. This is especially apt to be the case when loss of appetite attends the case—not an unusual feature.

Treatment.—The active production of milk should be as much as possible arrested, but not too suddenly. In mild cases **suckling** should be **gradually abandoned**, the infant being increasingly nourished with artificial foods, and **tonics** be administered to the patient. In the mean time the breasts should be moderately compressed with a **breast binder**. Moderate compression in many instances is all that is required, together with **restriction in the amount of liquids consumed**.

As soon as the child can be weaned, **iodide of potassium** can be employed in increasing doses, beginning with 5 grains (0.3 Gm.) three times a day.

The applications of a **belladonna plaster** or a weak solution of **atropine**—also **camphorated oil**—tend to reduce the excessive secretion, but there is always the danger of causing its cessation, so that the better plan is to **compress the breasts** moderately and administer in moderate doses internally **Rochelle salts**. As a tonic Mariani's **coca wine** can advantageously be employed, a wineglassful being given between meals. **Cocaine** and **mint** have also been recommended, but the danger of cocaine habit should always be borne in mind.

When the accumulation of milk cannot be sufficiently curtailed, the breast should be firmly compressed, withdrawing milk only when absolutely necessary.

-GALACTORRHEA.—The continuance of milk secretion, with constant flow between the nursing periods, is usually the result of poor health and requires removal of the cause with tonics, etc., and local measures such as are recommended for polygalactia.

JOHN C. APPLEGATE,
Philadelphia.

MANGANESE.—Manganese (manganum) in the metallic state is not used in medicine.

PREPARATIONS AND DOSE.—The official preparations of manganese are the following:—

Mangani dioxidum præcipitatum, U. S. P. (precipitated dioxide of manganese; black oxide of manganese), contains chiefly manganese dioxide [MnO_2] with small amounts of other manganese oxides, and occurs as a heavy, black, fine, odorless powder, insoluble in water or alcohol, but soluble in hot mineral acids. Dose, 3 to 10 grains (0.2 to 0.6 Gm.) in pill form.

Mangani hypophosphis, N. F. (manganese hypophosphite) [$\text{Mn}(\text{PH}_2\text{O}_2)_2 + \text{H}_2\text{O}$], occurs as a pink, crystalline powder, soluble in 6.6 parts of water. Dose, 1 to 5 grains (0.06 to 0.3 Gm.).

Mangani sulphas, N. F. (manganese sulphate) [$\text{MnSO}_4 + 4\text{H}_2\text{O}$], occurs in transparent, pale-rose, effervescent prisms, and has a bitterish, astringent taste, soluble in 0.7 part of water. Dose, 1 to 5 grains (0.06 to 0.3 Gm.) in pill form.

Potassii permanganas, U. S. P. (potassium permanganate) [KMnO_4], occurs in dark-purple, slender, opaque prisms, and has a blue, metallic reflection, and a sweet taste, with astringent after-taste, soluble in 15 parts of cold and in 3 parts of boiling water. It is incompatible with all oxidizable substances, particularly organic ones. For pills it should be triturated with kaolin and massed with petrolatum. With glycerin permanganate solutions form a violent explosive. Dose, 1 to 2 grains (0.06 to 0.13 Gm.) in pill form.

Syrupus hypophosphitum compositus, N. F. (compound syrup of hypophosphites), contains $\frac{1}{8}$ grain (0.008 Gm.)

of manganese hypophosphite in each fluidram (4 c.c.). Dose, 1 to 4 fluidrams (4 to 16 c.c.).

Liquor ferri peptonati cum mangano, N. F. (solution of iron peptonate with manganese), an agreeably flavored, non-styptic solution, represents about 0.4 per cent. of metallic iron and 0.2 per cent. of manganese in the form of peptonates, and contains about 25 per cent. of alcohol. Dose, 1 to 4 fluidrams (4 to 16 c.c.).

Syrupus ferri et mangani iodidi, N. F. (syrup of the iodides of iron and manganese), every 15 minims (1 c.c.) of which represent $1\frac{1}{2}$ grains (0.1 Gm.) of ferrous iodide and $\frac{1}{2}$ grain (0.03 Gm.) of manganese iodide. Dose, 15 minims (1 c.c.).

PHYSIOLOGICAL ACTION.—Manganese salts are absorbed from the alimentary tract only in small amounts—insufficiently to cause acute general toxic symptoms even after large doses. Injected hypodermically in animals, however, they produce distinct nervous and circulatory effects. According to Laschewitz, the organic salts of manganese in moderate doses, given subcutaneously, slow the heart rate, lower the blood-pressure, and induce paralytic phenomena. After death from manganese poisoning the heart was found dilated and did not respond to electrical stimulation. In a case of acute poisoning in the human being, however, Phillips found the heart arrested in systole. Kobert observed that intravenous injection of manganese salts first transiently stimulated the vasomotor center, then paralyzed it; later, the heart itself was depressed and finally paralyzed. The cardiac nervous mechanism suffered first, and later the muscle. After massive toxic doses of manganese compounds, death is preceded by epileptiform convulsions.

Manganese, like iron, is eliminated mainly by the intestinal epithelium, and in less amount by the kidneys.

POISONING.

ACUTE MANGANESE POISONING.

—In excessive doses manganese causes gastroenteric inflammation, hemorrhagic nephritis with bile and albumin in the urine (but no manganese), and death.

CHRONIC MANGANESE POISONING.—Emden reported 5 cases of poisoning among workers in manganese, through inhalation of the dust, and von Jaksch recorded 3 similar cases, in which the symptoms were irrepressible laughing and crying spells, muscular weakness and tremor of the lower extremities, exaggerated patellar reflex, a peculiar spastic gait, changed facial expression, and scanning speech.

Treatment of Poisoning.—Von Jaksch recommends **hydrotherapy, galvanization, faradization, exercise**, and the use of the **high-frequency current**.

THERAPEUTICS.—Manganese dioxide has at times proven useful in functional **amenorrhea**, especially when due to exposure to cold, and in **membranous dysmenorrhea**, in doses of 2 grains (0.12 Gm.), given in pill or capsule, four or five times daily. A. H. Smith found the **vertical headache** of cases of **dysmenorrhea** relieved by two or three doses.

In **anemia** and **chlorosis** manganese is considered by many beneficial, especially when combined with iron, as in the solution of iron peptonate with manganese (N. F.), given in the dose of a dessertspoonful or tablespoonful three or four times a day, either alone or in milk.

In **scrofula** and debility due to **chronic suppurative disease** the syrup of the iodides of iron and manganese (N. F.) is considered useful.

In **gastralgia** and **pyrosis** administration of the dioxide in doses of 10 grains (0.65 Gm.) has been recommended by Leared.

Potassium permanganate may be used with advantage as an antidote in **morphine, phosphorus, and snake-bite poisoning**. In 1884 B. Smith demonstrated its efficiency in morphine poisoning by taking 5 grains (0.3 Gm.) of morphine sulphate and a few seconds afterward 8 grains (0.5 Gm.) of potassium permanganate without suffering any narcotic effect. An equal quantity, grain for grain, of permanganate is antidotal. In cases of poisoning by opium (including laudanum) or the uncombined alkaloid morphine, acidulation of the antidotal solution with dilute sulphuric acid or white wine vinegar is advised, in order that the insoluble mor-

phine may be converted into a soluble salt.

In **phosphorus poisoning** the permanganate is a fairly dependable antidote. After washing out the stomach a pint (500 c.c.) of a 0.1 per cent. solution should be introduced and allowed to remain (Hagnos).

In **snake-bite poisoning** 20 minims (1.25 c.c.) of a 2 per cent. solution, freshly prepared, should be injected subcutaneously in 2 or more places, and especially into the orifices made by the fangs. It is a chemical, not a physiological, antidote, and does not preclude the use of antivenin.

Externally, potassium permanganate in solutions of 2 to 10 grains (0.12 to 0.6 Gm.) to the ounce (30 c.c.) of water is valuable as a deodorizer and disinfectant for **sloughing wounds, cancerous growths, ulcers, gangrenous areas, ozena, bromidrosis**, etc. In a 2 to 5 per cent. solution its use is advised in **leucorrhea**, and in a 1 to 2 per cent. solution as an injection in **gonococcal urethritis**. In conditions causing a foul breath dilute permanganate solutions may be used as a mouth wash or spray.

Popoff found a 1:2000 permanganate solution useful for relieving rebellious **toothache** due to dental caries. One tablespoonful was taken into the mouth every half-hour, and held on the affected side for several minutes. W. M. Barton similarly points out that 1:2500 or 1:5000 solutions, used in irrigations of the urethra, produced anesthesia of the mucous membrane of this canal; this procedure is used by him to reduce local sensitiveness prior to the passage of sounds in cases of **urethral stricture**.

W. and S.

MANIA. See **PSYCHOSES**.

MASTITIS. See **MAMMARY GLAND**.

MASTOID PROCESS, DISEASES AND SURGERY OF. See **MIDDLE EAR, DISEASES OF**.

MEASLES. — DEFINITION. — Measles—morbilli or rubeola—is an acute, infectious, contagious disease generally met with in children.

SYMPTOMS.—Measles runs a less variable course, as a rule, than does scarlet fever and some other infectious diseases. Very mild cases sometimes occur, however, while the disease occasionally runs a very severe course. In rare instances a malignant type is encountered. Among 115 cases Carr found the average duration of the disease when uncomplicated to be twenty-six days from the prodromal symptoms to the end of desquamation. The period of incubation of measles is about twelve days.

Measles usually begins gradually with feverishness, sneezing, coryza, suffusion of the eyes, and photophobia. Occasionally a chill followed by a high temperature is the initial symptom. Within twenty-four hours after the advent of the first symptoms a cough of peculiarly hard, dry character appears and the attack presents all the symptoms of a catarrhal cold. The coryza, however, is more marked than that of an ordinary cold. The fever often falls somewhat after the first day, a fact which may throw the physician off his guard. The coryza and cough, however, do not correspondingly diminish with the fall of the temperature, but usually increase. The eruption appears on the side of the face and is usually first seen on the afternoon of the fourth day and is accompanied by increased fever. The eruption may appear as early as the second day, particularly in young children, and is, in rare instances, delayed to the fifth or sixth day. Drowsiness is not uncommon during the stages of invasion, but there are no characteristic constitutional symptoms.

A distinct loss of weight has been observed by some authorities on the fourth and fifth days after exposure.

This is known as Meunier's sign. As described by that observer, it consists of a progressive loss of weight of about $1\frac{1}{2}$ ounces each day from the fourth day of the exposure to the onset of symptoms.

Koplik has described a symptom which he believes to be of great value in making an early diagnosis of measles. On the first day of invasion he has found that an examination of the buccal mucous membrane in a good light will reveal a scattered eruption consisting of small, irregular spots of bright-red color in the center of each of which is a minute, bluish-white speck. This he regarded as pathognomonic of measles. Most authorities now put much reliance upon this symptom. The spots are most abundant along the line of the molar teeth.

Koplik's spots do not invariably accompany or precede measles, but the writer has always found in cases which proved to be measles peculiar whitish efflorescences on the tonsils, punctate or linear, about 3 mm. long. This is a reliable sign and the earliest one of oncoming measles. It seems to be of the same nature as the Koplik spots, but it appears first and sometimes exclusively on the tonsils. Grumann (Münch. med. Woch., Jan. 20, 1914).

The temperature will occasionally be found at 103° or 104° on the first day, but it is usually not above 102° . The fever does not ordinarily range as high in measles as in scarlet fever. Not infrequently after a sharp rise on the first day the temperature falls on the two following days, but increases as the eruption appears and reaches its height on the second day of the eruption. From that time it gradually falls, and becomes normal between the seventh and ninth days of the disease. Not infrequently there is a sudden fall on the

sixth or seventh day, forming almost a crisis. The fall of the temperature after the initial rise on the first day is sometimes so decided as to lead to error in diagnosis. The possibility of such a fall is always to be considered. The fever and other constitutional symptoms are usually at their height when the eruption has reached its fullest development on the fifth or sixth day of the disease.

The rash usually appears on the afternoon of the fourth day, but in some cases is seen on the third day and in others is delayed until the fifth day. It is first seen on the temples and sides of the face, on the neck, or behind the ears. When it first appears it commonly consists of small red spots having no strictly characteristic appearance. They rapidly increase in size and form small macules or very slightly elevated papules on a slightly reddened base with normal skin between. They are circular or crescentic in shape, and, being hyperemic in nature, disappear on pressure.

As the eruption develops it tends to become confluent in places, particularly on the face, where it assumes a blotched appearance. There is usually a certain amount of edema, particularly about the cheeks and eyes, which farther tends to change the appearance of the patient. The eruption usually reaches its height at its first site of appearance at the end of thirty-six hours; it remains stationary for about two days, and then rapidly fades away. It extends over the body somewhat slowly, appearing on the trunk and limbs on the second day.

The wrists and backs of the hands are commonly the points to be last involved. When at its height in these places, the rash is sometimes partially faded on the face and neck. On the first day the

spots form simple macules, but later they become flat papules that can be readily felt by the fingers and are sometimes almost shotty to the touch. The rash commonly presents its most typical appearance on the chest.

The typical rash of measles is frequently accompanied by miliary vesicles and in rare cases petechiæ appear. Occasionally the rash, instead of assuming the usual hyperemic form, becomes distinctly hemorrhagic. This may occur in limited areas or may extend over the whole body. In the latter case it presents the type known as "black measles," a condition extremely rare in private practice. It indicates a severe form of the disease, but is not generally fatal, as is popularly supposed. The spread of the eruption is sometimes extremely rapid, the whole body being covered in a few hours, but this is rare. In other rare instances the rash is so slight and of such short duration as to be almost overlooked. The constitutional symptoms in such cases are, as a rule, correspondingly mild. Occasionally in malignant cases, marked by sudden or severe initial symptoms, the rash scarcely makes its appearance or is greatly delayed.

The constitutional symptoms reach their height during the stage of eruption, being usually at a maximum on the sixth day of the disease. They then remain stationary for about two days, when the fever abates and all the symptoms begin to subside. This sometimes occurs so suddenly on the sixth or seventh day as to form a crisis. This, however, is not the rule.

Albuminuria is not infrequent in the febrile stage, but nephritis is rare. The diazo reaction is found in about 80 per cent. of the cases. Leucocytosis occurs during the incubation period, and

reaches its maximum during the stage of invasion. As the eruption appears the leucocytosis subsides, and a normal count may be expected on the fifth day of the eruption. Leucocytosis later in the course of the disease means a complication.

In 14 children whose blood was examined during the incubation period of measles there was noted a pronounced reduction of the white corpuscles, fully four and one-half days before the eruption and three and one-half days before Koplik's spots were manifest. Two or three days before the eruption the leucocyte count was increased. In 1 of the cases the period of incubation was sixteen and in another twenty days. Resemblance between measles and serum sickness pointed out. Hecker (*Jour. Amer. Med. Assoc.*, from *Zeit. f. Kinderheilkunde*, Bd. ii, No. 1, 1911).

Urobilinuria occurred in all but 4 of 51 cases, that is, in 92 per cent. It rarely lasted more than a few days and was usually mild, never reaching the intensity of the urobilinuria in scarlet fever. When it was protracted there was always some complication justifying the assumption of insufficiency of the liver. Rach and Reuso (*Zeit. f. Kinderheilk.*, Bd. ii, Nu. 6, 1911).

There is an early change in the blood-picture in measles which may be taken as the first evidence of the infection. It consists in a change from the ordinary lymphocytic predominance which exists normally in infants' blood to a relative increase in the percentage of neutrophilic cells. The diminution in the lymphocytes far exceeds that of the neutrophiles, so that there is a complete reversal of the blood-picture. Lucas (*Amer. Jour. Dis. of Children*, Feb., 1914).

During the height of the disease the patient presents a very characteristic appearance. The face is covered by a

patchy eruption and is swelled and edematous; the eyes are red and sensitive to the light and are filled with a mucus or mucopurulent secretion; the nose is swelled and discharges a similar secretion; there is a dry, metallic, and very troublesome cough; the tongue is coated; the appetite is completely lost; the bowels are frequently relaxed; the child lies in a heavy and stupid condition, but is restless and irritable when disturbed. The glands at the angle of the jaw are often enlarged, and not infrequently the postcervical glands, also.

As the fever subsides, the cough rapidly changes its character, becoming looser and less irritating. It frequently disappears within a week, but sometimes the evidences of bronchitis continue, and the cough proves a troublesome symptom for several weeks. In most cases the photophobia subsides rapidly, but the eyes are prone to remain weak and watery. If strong light is admitted too soon a mild but very troublesome and persistent form of conjunctivitis may result. Other symptoms usually subside rapidly; the child becomes brighter and less irritable; the appetite returns, and evidences of illness soon disappear.

Desquamation begins as soon as the eruption has faded, and follows the order of its appearance. It rarely continues more than ten days in any given area, and may be of much shorter duration. It is most intense where the eruption has been most intense. It occurs in fine, branny scales quite unlike the lamellar desquamation of scarlet fever. It is often so slight as to be completely overlooked, particularly when inunctions of the skin have been carefully used. Desquamation is usually completed in from twenty to twenty-four days after the onset of the disease.

IRREGULAR FORMS.—Measles is capable of assuming very irregular and atypical forms. Such irregular types are most common in children under 3 years. Nevertheless, in a given number of cases a much larger proportion of measles cases will run a typical course than will a similar number of cases of scarlet fever.

Mild Type.—The disease may be extremely mild, the eruption being faint, the fever slight, and all the symptoms mild. Such cases present no variation from the usual type except that of mildness in degree. Although the catarrhal symptoms may be slight, the diagnosis of *morbilli sine catarrho* should be made with extreme hesitation.

Severe Type.—A severe form is sometimes seen, marked by unusually high temperature, intense eruption, and severity of all the symptoms. Except in young children, the uncomplicated disease, even when of severe type, is rarely fatal. But it should not be forgotten that a temperature that reaches an unusually high point or continues unabated as the eruption fades is usually due to some complication, commonly pulmonary. Any marked variation from the usual type demands particular attention, for it commonly indicates a complication.

Malignant Type.—Malignant measles, marked by intense and overwhelming symptoms from the outset, is fortunately rare outside of institutions. The same is true of hemorrhagic, or black, measles.

Relapse in measles is extremely rare and is, in fact, of doubtful occurrence. A secondary rise in temperature after a normal fall indicates a complication.

ETIOLOGY.—Measles is doubtless due to bacterial action, but no specific micro-organism has yet been positively identified. Its vitality is evidently small, though it must be extremely diffusible, for measles is the most contagious of the infectious diseases, except small-pox.

The writer has described gram-positive diplococci which she isolated in anaerobic cultures from the blood of measles and rubella patients. The diplococcus of measles is small and round, while that of rubella is larger, has pointed ends, and is elongated and encapsulated. From a study of smears taken from the most highly inflamed areas of the throats of patients having measles, rubella or scarlet fever and from normal persons the features of the smears were found to be of decided diagnostic value. In measles there were generally some polynuclear and epithelial cells and many of the small, round diplococci. Rubella throat smears showed few polynuclears, many epithelial cells, and many of the typical, elongated cocci, often showing capsules about the pairs and frequently appearing within the epithelial cells. Smears from scarlet fever throats showed many polynuclears and a variable number of cocci in pairs or short chains and having a wide capsule. None of the diplococci found in the throats in these three diseases were found in smears from normal throats, except in four persons recently in close association with rubella cases. Ruth Tunnicliffe (*Jour. Amer. Med. Assoc.*, July 13, 1918).

The chief bacteria to engage the attention in connection with measles at present are: (1) the diplococcus found by Tunnicliffe in the blood early in the attack and in the throat and nose; (2) influenza bacilli, and (3) hemolytic streptococci. As opsonins and probably other bodies specific for the Tunnicliffe diplococcus come into the blood in the course of

the measles attack, this coccus must be of some significance, but the exact significance we have still to learn. While hemolytic streptococci seem to predominate overwhelmingly in the broncho-pneumonia and other allied acute processes in measles, influenza bacilli are found so frequently in the throat secretions and in lung lesions that doubt arises as to their harmlessness. Hence the part played by these bacilli in measles should be studied further. Hektoen (*Jour. Amer. Med. Assoc.*, Oct. 12, 1918).

Its occurrence is uncommon under six months, but above that age every child who has not already had it may be expected to contract it upon exposure.

Adults are rather more susceptible to it than to the other infectious diseases. Measles is endemic in all large towns, but at intervals it becomes epidemic and spreads over a wide area before it expends itself. Sex is not a predisposing factor.

Where the disease is introduced for the first time it attacks adults and is often fatal. In 1875, in the Fiji Islands, 40,000 of the 150,000 inhabitants died of measles. T. J. O'Meara (*Med. Press and Circ.*, Sept. 6, 1911).

Of 1000 cases of measles studied, the greatest number occurred in the month of June (186). The third year age period showed the greatest incidence of attack (195). The largest complication percentage, 81.3, and case mortality, 34.3 per cent. were found in the first year period. The seasonal prevalence of complications was highest in December, 78.6 per cent., and of case mortality in January, 25.2 per cent. The most frequent complication was otitis media, 495. The most common causes of death were bronchopneumonia and enteritis, 23.3 per cent. of total deaths. Average duration of the fever, four days. The onset of purulent otitis media on the tenth or twelfth day

may not be attended by unusual fever. If the temperature remains high after the fourth day, a possible complication is imminent. Craster (Am. Jour. Dis. of Child., Aug., 1913).

Sources of Infection.—Measles is transmitted by direct contact, but the area of contagion is large. Although intermediate contagion may occur, it is comparatively rare. The infectious power of the poison is quickly lost, so that sick-rooms very soon become safe for occupancy.

It is probable that contagium may be conveyed by the breath; but it is certain that it resides in the sputa and the discharges from the nose and eyes. Ample experimental evidence has shown, however, that infection is not carried through the air for a distance greater than 9 feet.

If the contagion resides in the desquamation scales, it is far less potent than is the poison carried by the desquamation of scarlet fever. The disease may be conveyed by clothing or it may be contracted by a susceptible person entering a room recently left by a measles patient.

Seventeen specimens of measles sputum were examined by the writer on the first or second day after the appearance of the eruption. Direct smears of the washed sputum showed small (0.5 microns) round or very slightly elongated Gram-positive diplococci. The diplococcus was isolated from all of the sputum examined. *B. influenza* and *S. hemolyticus* were each isolated twice. Ruth Tunncliffe (Jour. of Infect. Dis., Feb., 1919).

Incubation.—The period of incubation ranges from nine to twenty-one days. Holt found it to be between eleven and fourteen days in 66 per cent. of 144 carefully observed cases. I have repeatedly seen the initial symptoms appear 12 days after ex-

posure which corresponds with the evidence available in literature.

The writer observed 2 typical attacks of measles in his own child with an interval of 3 years, and collected records of 46 families. There had been 71 cases of measles in which the incubation period could be determined with precision: 10 days in 15 cases; 9 in 12; 11 in 12; 8 in 10; 7 in 5; 12 in 5; 13 in 5; 6 in 2; and from 14 to 19 in 1 case each. Lewy Zeit. f. Kinderheilk., Aug. 16, 1920).

Transmission.—Measles may be contagious from the first appearance of the catarrhal symptoms, authentic cases being recorded in which the disease was transmitted four days before the eruption appeared. It is most contagious during the height of the catarrhal stage and until the eruption has reached its climax. The contagiousness diminishes as the active symptoms subside, and is slight during the stage of desquamation. Except in complicated cases, in which the catarrhal symptoms are usually prolonged, the period of infection is not over twenty-eight days.

The writers succeeded in infecting a monkey of the species *Macacus sinicus* with measles by injecting intraperitoneally 6 c.c. of the blood of a child suffering from the preliminary symptoms of the disease. This shows conclusively that measles is contagious before the eruptive stage. C. Nicolle and E. Conseil (Acad. de Méd.; Bull. méd., Jan. 3, 1912).

The writers produced measles in monkeys by inoculation of blood-serum from a patient thirty-six hours after the initial rise of temperature and six hours before the appearance of the rash. The monkeys, after a definite incubation period of six days in 1 case, showed systemic signs, and on the tenth day Koplik spots could be seen. Lucas and Prizer (Jour. of Med. Research, Apr., 1912).

Monkeys which recovered from experimental measles were found immune to reinfection with the virus whether the latter was of homologous or heterologous origin. This corresponds with measles in human beings, whether the virus is inoculated on the respiratory mucosa or is injected intravenously. Blake and Trask (*Jour. Exper. Med.*, May 1, 1921).

PATHOLOGY.—In uncomplicated measles the lesions are confined to the skin and the mucous membranes of the conjunctivæ, nose, pharynx, larynx, and the larger bronchial tubes. The morbid changes of the skin are those of acute hyperemia; on the mucous membranes they are those of acute catarrh. In complicated cases pseudomembranous inflammation may occur. Death rarely results from the simple disease, but rather from the complications, which will be considered later. The complications are due to mixed infection, the germ most commonly present being the staphylococcus. The streptococcus is, however, frequently present, and, as a rule, causes more serious lesions than those of the staphylococcus. The mucous membranes are rendered very susceptible by measles to these germs. As they are invariably present in the wards of hospitals, the disease in such institutions is always a dreaded one, for it is prone to be complicated.

The essentials in the cutaneous lesions of measles are: (1) Focal necrosis with the formation of small vesicles; (2) isolated necrosis of epithelial cells; (3) diffuse perinuclear vacuolation of epidermal cells and of dermal glandular structures; (4) congestion, edema, swelling, and proliferation of epithelial cells, and a marked increase of large round cells. In the mucous membranes of the pharynx and respiratory tract there

is an extensive subepithelial infiltration with round cells and also focal necrosis. Koplik's spots probably result from focal processes of this kind. Ewing (*Jour. of Infect. Dis.*, Feb., 1909).

The phagocytic activity of the leucocytes is decreased for the streptococcus, staphylococcus, and tubercle bacillus during the period of leucopenia in measles. The activity becomes normal, however, with the increase in number of the leucocytes. R. Tunnicliff (*Jour. of Infect. Dis.*, Nov., 1912).

Abnormally high toxicity of the urine is not peculiar to measles, but may be encountered in diphtheria, scarlet fever, peritonitis, and other affections. Mautner (*Deut. med. Woch.*, Nov. 21, 1912).

The eruption in measles is an anti-toxic reaction to the organisms causing the disease, which are located in the capillaries. The organisms are agglutinated and the eruption appears when the capillaries of a given region become saturated with antibodies. This saturation takes place first in the regions having the most abundant blood-supply, such as the mucous membranes and the regions near the heart and large blood-vessels. Gradually the organisms are removed from the circulation by agglutination. By the time the parts with a less abundant blood-supply, such as the elbows, feet, and nates, have developed a sufficient supply of antibodies, there are no longer any organisms to agglutinate; therefore, those parts show no eruption. C. v. Pirquet (*Zeit. f. Kinderheilk.*, Bd. vi, Nu. 1, 2, 3, 1913).

COMPLICATIONS AND SEQUELÆ.—The most common and serious complications of measles are bronchopneumonia, membranous laryngitis, and otitis; the most common sequelæ are tuberculosis and conjunctivitis.

Bronchial catarrh is an essential

part of measles, but it is very easy for the inflammation to extend from the smaller bronchi to the alveoli, thus transforming a normal condition into a most serious complication,—namely, **bronchopneumonia**. The younger the child, the greater is this danger. It occurs chiefly in children under 3 years, and is comparatively rare in children over 4 years. It is very common in institutions and renders measles the most dreaded of all epidemic diseases in infant hospitals, diphtheria being no exception to the rule. In an epidemic of measles in the Infants' Hospital of New York every case in children under 18 months was complicated by bronchopneumonia or **croup**, and 80 per cent. died. The pneumonia usually made its appearance soon after the eruption reached its height, but developed in a few cases during the stage of invasion, the disease being regarded in two instances as simple bronchopneumonia until the eruption suddenly appeared. According to Holt, 10 per cent. of all cases are complicated by bronchopneumonia. He agrees with Henoch that a certain amount of pneumonia is found at autopsy in almost every fatal case. Carr found it clinically 21 times among 115 hospital patients.

Lobar pneumonia is an occasional complication of measles in children over 4 years, but is seldom if ever found under 3 years. **Empyema** is sometimes a sequel of such complicating lobar pneumonia. The signs and rational symptoms of either form of pneumonia complicating measles present nothing unusual.

Study of 437 cases of measles affording striking evidence of the fact that death in this affection de-

pends upon the pulmonary complications, such as bronchitis, pneumonia, and bronchopneumonia. In the first five years of life the curves of incidence of pulmonary complications and of death are parallel. The total death rate of the epidemic observed was 5.03 per cent. Severe pulmonary complications were present in 23.57 per cent. of all cases. Tait (Brit. Med. Jour., June 29, 1912).

In 388 cases in troops, broncho-pneumonia occurred in 47, or 12.1 per cent. Of these, 15 or 34 per cent., developed empyema. The pleural fluids showed *S. hemolyticus*. Levy (War Med., Paris, Nov., 1918).

Catarrhal pharyngitis is an essential part of measles; **pseudomembranous pharyngitis** sometimes occurs as a complication. Instead of invading the nose and ears, as in scarlet fever, it shows a strong tendency to invade the larynx; but **croup** frequently develops without the appearance of membrane in the pharynx.

As in scarlet fever, the pseudomembranes which develop during the height of the attack are usually due to streptococci, and are, therefore, not true diphtheria. Those which develop later are usually due to Klebs-Loeffler bacilli and are true **diphtheria**. This secondary streptococcic disease, however, is quite as fatal as the bacillary disease. Not only is the child in imminent danger from laryngeal complications, but it is almost certain, also, to develop bronchopneumonia, which occurs as the direct result of streptococcic infection. The differential diagnosis between true and false diphtheria can rarely be made with certainty from clinical appearances alone. Fortunately, in private practice both complications are rare in children over 4 years.

Otitis, while less common than in scarlet fever, sometimes occurs, but does not usually prove so serious. Both ears are usually involved, but the disease presents in its symptoms and course nothing worthy of particular mention.

Complete **anorexia** is common during the febrile stage. **Diarrhea** is of frequent occurrence and may be so severe as to prove a serious complication. It may be due to simple intestinal indigestion, or it may be the evidence of enterocolitis. It is occasionally so severe as to prove a serious complication.

Febrile **albuminuria** is not infrequent in cases with high temperature, but nephritis is very rare.

Kidney complications are frequently overlooked in measles. The writer found **pyelitis** or **pyelonephritis** in 9 out of 147 cases of measles, and **albuminuria** in 59 others. In some cases the absence of anything else to explain the persisting high fever first led to examination of the urine, with resulting discovery of the kidney complication. **Nephritis** was discovered in a tenth case of mild measles. All but 2 of the 10 children were girls, and the kidneys were known to have been previously healthy. Biehler (*Archives de méd. des enfants*, Oct., 1909).

Nervous symptoms, excepting the occasional appearance of **convulsions** at the outset, are rare.

In several cases of measles the writer encountered a **neurosis of the sympathetic system**. One typical instance was in a child nearly 2 years old. During the eruptive stage **spasm of the larynx** developed. The vocal cords seemed to contract slowly until the carbon dioxide accumulating in the blood stimulated the respiratory center and induced a profound inspiration. The spasm was then suspended for an instant. While

considering intubation, mustard to the chest and bromides, cannabis indica, and belladonna were given, and in a few hours the spasm subsided. It returned again two days later when it yielded as before to the same measures. Another child had attacks of typical **asthma** for the first time during measles. In a third the **spasm** affected the **intestines**; the intense pain, unaccompanied by any objective signs, continued unmitigated until relieved by the same measures used in the other cases: bromides, cannabis indica, and belladonna. S. Licciardi (*Jour. Amer. Med. Assoc.*, from *Gaz. degli Osped.*, Oct. 26, 1909).

Endocarditis and **pericarditis** are seen in rare cases.

Meningitis may occur as a further complication, through the presence of otitis.

Cellulitis and **suppurative adenitis** are uncommon, but moderate **enlargement of cervical glands** often occurs and sometimes persists for months.

The occurrence of measles simultaneously with other infectious diseases is not very infrequent. There seems to be a particular tendency to the simultaneous occurrence of measles and **pertussis**.

Five cases of **scarlet fever** succeeding measles. All the patients recovered without any complication. The gravity of the former disease, supervening on the latter, depends on whether the latter is complicated or not by bronchopneumonia or bronchitis. If scarlet fever and measles coexist (a very rare condition), the eruptions are simultaneous, but this association is not serious. The most serious condition is when measles succeeds scarlet fever. Out of 15 of the author's cases 4 died, all from pulmonary complications. The shorter the interval between the two fevers, the more grave the outlook. Hutinel (*Jour. de méd.*, Jan., 1911).

Tuberculosis is the most serious sequel of measles. It commonly occurs as a tuberculous bronchopneumonia, general miliary tuberculosis, tuberculous adenitis, or tuberculous joint disease. These conditions may result from primary infection or from the lighting up of some old tuberculous process. Measles unquestionably renders the tissue very susceptible to tubercle bacilli, so that infection may result from slight exposure. **Acute miliary tuberculosis** may follow measles at once, the temperature range being continuous from the outset of the primary disease to death from the complication. General tuberculosis with grave pulmonary involvement may follow so close upon measles as to leave no appreciable interval between. It is sometimes the cause of a secondary fever, which develops soon after the subsidence of the primary fever. Tuberculous disease of the bones and joints subsequent to measles is usually of late occurrence.

Chronic conjunctivitis is a frequent sequel of measles which may be in large degree prevented by judicious care. **Iritis** and **keratitis** are possible sequels, but are not common.

DIAGNOSIS.—Measles is distinguished from scarlet fever chiefly by the coryza and other catarrhal manifestations of the former, the absence of leucocytosis, and the presence of Koplik's spots. Sore throat, a diffuse eruption, and glandular enlargement are suggestive of scarlet fever, but at times prove unreliable diagnostic guides, being sometimes present to a moderate degree in measles.

Tuberculous children lose their reaction to tuberculin during the measles attack for about a week.

This is probably due to destruction of the tuberculosis antibodies. C. von Pirquet (*Deut. med. Woch.*, Bd. xxxiv, S. 1297, 1908).

Especially noticeable in measles is the decrease in the number of lymphocytes for several days before the onset of symptoms. This premonitory leucopenia and lymphopenia is a valuable sign of the incubation period of measles. Hecker (*Münch. med. Woch.*, Oct. 12, 1909).

The writer examined 947 measles patients for the Koplik spots. They were found the day before the eruption in 864 cases, two days before in 42, and up to ten days before in 1 instance. Biehler (*Arch. de méd. des enfants*, Jan., 1911).

When dry cupping was applied to the chest or back for 30, 40 or 50 seconds, in 200 healthy persons there was left a whitish ring where the cup had rested. When applied to a person during the incubation stage of measles, 3 days before the eruption appeared, a reddish ring was seen, the skin looking as if it were stippled with red in the form of a circle. If applied 48 hours before the eruption, the red circle is much wider and the color deeper; 12 hours before the eruption the red circle is still wider and the color veers more to purple. This induced erythema reaches its height in three and a half minutes and then subsides, lingering sometimes up to 10 minutes. The 18 who gave a positive reaction developed a typical measles eruption 4 or 5 days afterward. Godlewski (*Bull. Soc. Méd. des Hôp.*, Nov. 23, 1917),

From rubella or German measles (*q.v.*), rubeola is differentiated mainly through the slight or absent prodromata, the absence of Koplik's spots, and also through the earlier and more evanescent eruption in the former affection. The papules in rubella, which often appear as the first observable symptom, are more discrete than in measles. Fever is

not so pronounced and complications do not occur.

In the differential diagnosis between scarlet fever, measles, and German measles a clinical sign which often proves very helpful consists in free perspiration during the entire course of German measles, whereas the skin is invariably dry and more or less hot in scarlatina and morbilli. The free perspiration is due to the fact that in German measles not only the lymphatic glands (including the spleen, which is often greatly enlarged), but the sudoriferous glands as well, are involved. Herman B. Sheffield (*Med. Rec.*, Aug. 9, 1913).

From small-pox and typhus, with which it has been at times confounded, measles is distinguished by the Koplik spots and, in general, by the less violent constitutional manifestations.

The prodromal conjunctivitis of measles presents special characters which distinguish it from that of ordinary coryza. In the latter the injection of the mucous membrane usually begins at the cul-de-sac of the eyelids, whence it extends to the ocular and palpebral surfaces. In the early conjunctivitis of measles the first sign of injection is observed on the bulbar conjunctiva on either side of the cornea directly opposite the palpebral fissure. If seen sufficiently early, the redness occupies the usual situation of pterygium, but spreads so rapidly that by the following day the whole mucous membrane of the eye is involved. This sign was found in over 70 per cent. of the cases examined. A. Aly-Belfadel (*Semaine méd.*, Jan. 8, 1908).

Exanthemata very similar to that of measles occur, among other infections, in dengue, bilious typhoid, and Rocky Mountain fever. Goetz (*Jahrbuch f. Kinderheilk.*, Aug., 1912).

PROGNOSIS.—Death from measles in private practice is rare in children over 4 years of age. Holt, after

the study of a large number of cases, concludes that the mortality of the disease is from 4 to 6 per cent., but under 2 years it is often 20 per cent. or more. It is highest between 1 and 2 years, but even at this age uncomplicated measles is not a highly fatal disease. Pneumonia is the cause of death in almost 90 per cent. of fatal cases.

A violent onset with high temperature warrants a guarded prognosis. A rising temperature with a fading eruption warrants an unfavorable prognosis. The same is true when the eruption is excessive in amount and confluent over wide areas. Grave general symptoms with faint eruption is a serious condition. The same is true of a hemorrhagic or black eruption, but it is not as necessarily fatal as is commonly supposed.

Measles has a marked tendency to leave behind it results of a serious nature. Treatment should not be directed solely to saving the life of the child nor should the prognosis be made up solely with reference to that event. The tendency to tuberculous invasion should never be forgotten, and when the fever persists after the tenth day, even if it is not high, the prognosis should be guarded. The list of chronic affections left in the wake of measles is a long one; bronchitis, pharyngitis, rhinitis, adenoid growths, enlarged tonsils and mesenteric glands are among the number which should receive consideration.

PROPHYLAXIS.—The advisability of taking particular precautions against the exposure of infants is suggested by the high mortality of measles before 3 years. Delicate children of the so-called scrofulous type and those with hereditary tendency

to tuberculosis should be especially guarded against exposure. Early and absolute **isolation** of the sick is imperative. **Quarantine** of the patient should not be less than twenty-eight days and as much longer as purulent discharges may continue. The period of quarantine after exposure should not be less than fifteen days, and twenty days is preferable. Children who have been exposed should be isolated from other children for that period.

The sick-room is less liable to prove dangerous than is the scarlet-fever sick-room. Thorough **cleansing** and **ventilation** for two weeks after the patient has left it are sufficient to insure safety. The infection of measles is not persistent nor is intermediate infection common, so that prolonged precautions are not necessary. During the height of the disease the same measures should be taken to **avoid the exposure of others** as in other infectious diseases.

Much stress has recently been laid upon the efficacy of **gowns, caps, and personal disinfection of attendants** in the prophylaxis of infectious diseases, especially diphtheria and scarlet fever. Such measures should always be adopted in measles, but it is the consensus of opinion that they are of less value than in the diseases mentioned. With that belief I am in full accord. **Absolute isolation of the patient and prevention of contact with non-immunes** should be enforced.

Statistics of the effect of school closure upon the course of an epidemic of measles during which 4470 children were exposed to infection. Of these, 2180 were presumably susceptible. Of these latter, 853 were attacked, 638 cases occurring during the time that the children were at

school and 140 during a period of fourteen days after school closure; that is, 778 patients might have become infected either at school or at home. Thus, at the time of removal of the possibility of school infection, there remained more than 1400 susceptible children. Of these, however, only 75 caught the disease. This shows what an important part the school plays in the spread of measles and the value of **school closure** in an epidemic as a preventive measure. Raffle (*Lancet*, Feb. 3, 1912).

The writer's experience confirms the fact that the **eucalyptus oil neck bag** is effectual in the prophylaxis of measles. Elgart (*Med. Klinik*, Aug. 3, 1913).

The writer injected serum from the oldest child in a family of 4, at the seventh day of convalescence from measles, hoping thus to ward off the infection from a boy of 2, the youngest in the family. He did not develop the disease although constantly with his 3 brothers who all developed the disease in turn in the course of 3 days. Nicolle and Conseil (*Bull. Soc. Méd. des Hôp.*, April 12, 1918).

Complement fixation tests were made by the writers with measles and rubella serum using, as a rule, a suspension of the diplococci isolated from the blood of measles patients, but also a mixture of strains, as the measles antigen, and a mixture of strains isolated from the blood and throat of rubella patients for the rubella antigen. The results indicate that the serum of measles and rubella patients contain complement fixing bodies for their respective diplococci to a slight degree early in the disease at about the same time the increase in opsonins occurs. Tunnicliffe and Brown (*Jour. Infect. Dis.*, Dec., 1918).

Six children, definitely exposed to measles, were apparently protected from the disease by **immune serum**; one, used as a control, developed measles. Eight others were partially exposed and did not develop the disease after immunization. Three other patients received virus inoculation

and immune serum simultaneously. In two there was no reaction. In the third there was a slight reaction indicated by a transient rise in temperature and an atypical rash. Richardson and Connor (*Jour. Amer. Med. Assoc.*, Apr. 12, 1919).

TREATMENT.—The patient should be placed in as **large and well ventilated a room** as possible. The temperature should not be kept at too high a point nor should the child be forced to swelter under too heavy covering. It accomplishes no good and renders the child restless and irritable. The **room** should be **kept very dark** and **no direct light** should be permitted to fall **upon the eyes**. As the inflammation of the eyes subsides, the light should be gradually admitted, but full light should not be permitted until the conjunctivæ have become normal in appearance. Itching of the lids should be relieved by **cold cloths** or by the application of **cold cream** or some **bland oil**. If a purulent discharge appears, the eyes should be kept clean by a frequent application of a solution of **boric acid**.

The child should be put to **bed**, even in the mildest cases, and kept there until desquamation is practically completed. The **diet** should consist of **milk** and **broth** during the febrile stage; during the height of the disease the child should not be over-urged to eat.

Applications of plain or **carbolyzed petrolatum** do much to reduce the irritability of the skin. As soon as the eruption begins to subside, inunctions of plain or carbolyzed petrolatum or **ichthyol ointment** should be practised daily. A **daily warm bath** does much to hasten desquamation.

The hard, metallic cough is one of the most troublesome symptoms of

the disease. **Very little relief**, however, can be afforded by treatment before the fever begins to subside. It cannot be loosened by the administration of nauseating expectorants. They tend to render the child more irritable and to increase the anorexia and have but slight effect on the cough. Small doses of **opium** aid in allaying the cough, and are quite permissible. **Brown mixture** in the form of tablet triturates is as effective as any treatment and is easy of administration.

Though hyperpyrexia is uncommon in measles, the fever sometimes requires attention. The effect of the fever upon the patient is a better guide for treatment than is the thermometer. If the child becomes restless or delirious small doses of **acetphenetidin** are admissible. Only enough should be given to reduce the temperature moderately and to allay restlessness. **Cold sponging** is the best treatment for high temperature and is far preferable to the administration of large doses of antipyretics.

Good results obtained by the subcutaneous injection of **pilocarpine nitrate** in doses of 1 mg. ($\frac{1}{41}$ grain), repeated as necessary. The author has treated 45 cases, with 2 deaths—which he attributes to pneumonia. This method was found an almost certain cure for the very severe obstructive forms of laryngitis occurring at any time during measles. This laryngitis may be stridulous or pseudomembranous; in the author's experience the latter is not bacteriologically a diphtheritic laryngitis. A. Montefusco (*Giorn. Intern. d. Sci. Med.*, xxx, 30, 1908).

The active agent of measles and its toxin lose their pathogenic properties rapidly under the influence of **red light**. The light exerts a strong abortive action on the disease. The

feverish state quickly disappears. Even one of the most dreaded complications, bronchopneumonia, is benefited or cured by this treatment. Simonescu (*Presse méd.*, Aug. 1, 1908).

The writer employed the following treatment with surprising results in the cure, and in the prevention of the spread of, both measles and scarlet fever, even in institutions, without adopting methods of isolation or disinfection. For twenty-seven years he has used pure **eucalyptus oil** in the following manner: During the first four days this oil is gently rubbed in, morning and evening, all over the body. The treatment is kept up until the tenth day of the disease. The tonsils and pharynx are swabbed with 1:10 **phenol** in oil every two hours for the first twenty-four hours, rarely longer. When this is begun early, secondary infections never occur and complications are unknown. If the treatment is carefully carried out, children may occupy the same room and even the same bed without risk of infection. No quarantine is necessary and other children in the family may be allowed to attend school. No after-disinfection is required. Milne (*Brit. Med. Jour.*, Sept. 2, 1911).

Milne's method, with additions, employed in 160 cases of measles: A **hot bath** was first given, then a thorough application of **eucalyptus oil** to the whole body, with the exception of the hands and the nose, mouth, and eyes. The mouth was irrigated twice daily with a weak **alum lotion**, and **glycerin and borax** applied to the interior of the mouth and to the gums. The throat (tonsils and fauces) was treated with **phenol** (1:10) morning and evening, using a firm mop of cotton-wool on the end of a pair of forceps. On each of the following four days the child was blanket-bathed morning and evening, and again rubbed over with eucalyptus oil, the throat and mouth having the same treatment as on admission.

In the cases thus treated the total number of deaths was 8, giving a case mortality of 5 per cent. Among 100 cases previously treated without inunction the mortality had been 11 per cent. D. I. Connolly (*Pract.*, Nov., 1912).

Two Arabs were brought to the base hospital with extreme collapse in the course of measles. One speedily died, but the other recovered after **transfusion of citrated blood from a measles convalescent**. The eruption was diffuse and ecchymotic, the fever up to 41° C., with collapse, anuria, incontinence and toxic dyspnea. After transfusion of 100 c.c. of blood from a man who had been cured of measles for a week, in two hours the vital functions had recuperated and speedy recovery followed. Ribadeau-Dumas and Brissaud (*Bull. Soc. Méd. des Hôp.*, Feb. 15, 1918).

Study of an outbreak of 444 cases of measles among 13,773 troops showed that the disease should be classed among the respiratory diseases. Munson (*Milit. Surgeon*, cited by *Amer. Jour. Med. Sci.*, Feb., 1918).

Uncomplicated cases do not require **stimulants**. Bronchopneumonia requires the same treatment that it would receive under other conditions. Other complications must be treated as they arise.

Phlyctenular conjunctivitis, with its array of dangerous complications, including ulceration of the cornea, is often witnessed in dispensaries as a sequel of measles. This is mainly due to the fact that textbooks on diseases of children do not lay sufficient stress upon the importance of keeping the lids **aseptic by careful cleansing**, and **not using the eyes** for reading, writing, etc., until the system has completely recovered from the debilitating influence of the disease, in which the ocular muscles take an active part.

During convalescence, unusual care should be exercised in **avoiding unnecessary exposure**. Tonics should be given freely. The various sequelæ should receive proper attention, and the particular susceptibility to tuberculosis should not be forgotten.

The writer found that in an infant of 13 months the rash lasted only 1 day and even **mustard packs** failed to bring it out again. The child's strength was kept up with **camphorated oil** and daily **glucose-adrenalin** injections. The condition growing constantly worse, a subcutaneous injection was made the fifth day of 20 c.c. of **whole blood** from a brother who had had measles 6 months before. By evening the infant was playing in his bath, and he slept that night for the first time. The temperature began to go down, and by the next day the child was well. The writer emphasizes the rapid improvement after this plasma-therapy. The antibodies had evidently persisted for 6 months in the donor. Terrien (Bull. de la Soc. Méd. des Hôp., Dec. 26, 1919).

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MELANURIA.—The urine in cases of melanotic tumor at times contains melanogen, which upon standing or addition of oxidizing substances or alkalis changes into melanin, causing a blackish discoloration. Upon addition of ferric chloride, intensification of the shade may occur, or a black precipitate result which will dissolve in a solution of sodium carbonate. From this solution mineral acids will reprecipitate it. The black pigment may also occur in chronic malaria. S.

MENINGES AND BRAIN, DISEASES OF.—A number of the more important diseases of the brain and spinal cord are treated under special headings: CEREBRAL ABSCESS;

CEREBRAL HEMORRHAGE; MENINGITIS, CEREBROSPINAL; TABES DORSALIS, etc.

HYPEREMIA.

This alleged condition, also called "rush of blood to the head," is described in some textbooks, and is popularly spoken of as not uncommon. It is doubtful, however, whether it is to be recognized as a distinct clinical entity. Variations of the volume of blood in the brain doubtless occur, but the condition of hyperemia is probably but transient. It may presumably occur in persons who have impaired arteries. There is a sense of fulness in the head, flushed face, perhaps giddiness and mental confusion. A simple hyperemia, however, would not cause paralysis or loss of consciousness. On the whole, it is best not to elaborate the subject. Some of the symptoms ascribed to it are probably due to various toxemias.

ANEMIA.

Anemia of the brain occurs in various conditions; in fact, it may occur in so many conditions that it is to be regarded rather as a complication of other diseases than as a distinct disease in itself. Severe hemorrhage from any region of the body may cause it; also the withdrawal of large accumulations of fluid, such as ascites, which acts apparently by withdrawing blood from the vascular system generally. In many chronic wasting diseases there is deficient and impaired blood in the vessels generally, and some of the symptoms may be due to cerebral anemia. Such diseases are pernicious anemia, cancer, tuberculosis, and chronic Bright's disease; but in all such cases there is a cachexia, which probably accounts for the symptoms. Syncope, from what-

ever cause, is probably due to an interrupted blood-supply to the cardiac and respiratory centers. In arteriosclerosis there may occur transient symptoms, such as mental changes, even aphasia and paralysis, which are most readily explained by an interruption in blood-supply. No attempt will be made to describe cerebral anemia as a distinct affection, its symptoms being best considered in conjunction with the various diseases of which it is an occasional effect.

EDEMA.

Edema of the brain does not occur as a distinct disease. An edematous or "wet" brain is found in a number of grave organic affections, such as chronic alcoholism, paresis, etc., but it is then merely a terminal condition, and is best studied as a part of these affections.

ENCEPHALITIS.

DEFINITION.—By encephalitis we understand an inflammation of the encephalon, or brain. The encephalon properly includes the whole content of the cranium: thus the brain with its various subdivisions,—the hemispheres of the cerebrum, the mid-brain, the pons, the medulla, and the cerebellum,—together with the enveloping membranes, is included in the term. Brain abscess, although properly included in purulent meningoencephalitis, will not be discussed here, having already been considered under CEREBRAL ABSCESS (*q.v.*).

VARIETIES.—Among the forms of encephalitis other than purulent meningoencephalitis which will be briefly described are the so-called hemorrhagic encephalitis, and the circumscribed polioencephalitis of Wernicke and of Strümpell,

It must be understood that inflammation of the brain and its membranes is a process that occurs under many conditions and from numerous causes. The pus-forming micro-organisms are the common, if not the only, causes. Thus, in tuberculous meningitis there is usually some involvement of the cerebral tissue with formation of pus. In cerebrospinal meningitis, due to *Diplococcus intracellularis*, there is also a purulent exudate. Syphilis causes a specific meningocerebritis with a gummatous exudate.

One of the commonest causes of encephalitis is purulent otitis media, due usually to the streptococcus. Infection may arise also from purulent disease of other bones of the cranium, as of the nose and its accessory sinuses, and of the orbit. The resulting infection may lead to purulent meningitis, or to brain abscess, or to both. The pneumococcus, however introduced, may cause meningitis. Possibly other microbes will yet be observed to cause a similar infection. Trauma to the bones of the cranium may cause inflammation of the brain and its membranes, doubtless by secondary infection. A septic focus in any region of the body may cause secondary infection in the brain, but the commonest are abscess of the liver, ulcerative endocarditis, abscess of the lung, and empyema. In these cases the brain lesion is usually a metastatic abscess.

PURULENT MENINGOENCEPHALITIS.

Under this heading we shall describe the commonest form of inflammation of the encephalon, merely premising that in this affection the

membranes are usually involved along with the brain proper.

SYMPTOMS.—Chill, fever, headache, vomiting, convulsions, paralysis, rigidity, optic neuritis, and affections of consciousness are the chief symptoms.

Chill, or a succession of chills, sometimes occurs with an acute onset, but often the history of a rigor is not obtained. The onset may be rather gradual and insidious, without premonitions.

Fever is usually present, but its course is irregular. It may be accompanied with chills and sweating, and runs the usual course seen in sepsis.

Headache is commonly observed. It is either diffuse or marked by localized pain. In case of solitary abscess it is not always observed, but *per contra* it is sometimes intense. Its localizing value is not often great. Pressure may elicit tenderness, especially over and about the mastoid region in otitis media.

Vomiting is not uncommon. It often presents the type known as cerebral, in which the act of vomiting is propulsive, without nausea, and without reference to the presence of food in the stomach.

Convulsions are general or local, but they are not inevitable. The local convulsions are due to irritation of the motor centers, and are then localized in the limbs or muscle groups innervated from such centers.

Paralysis is usually a late manifestation, and is caused by involvement of the motor cortex or by pressure on the subcortical tracts, or the descending motor fibers. It may be *focal*, i.e., located on one side, or in one limb, or even in a few muscle groups, according to the area of the brain involved.

Focal convulsions are very likely to be followed by focal paralysis. Paralysis of the eye muscles is sometimes caused by involvement of the third, fourth, and sixth nerves in the inflammatory process.

Rigidity, as a sign of meningeal irritation, is sometimes observed, especially about the nuchal region. It is occasionally seen in one or more limbs.

Optic neuritis, or choked disk, is an important symptom. It may progress rapidly and threaten the integrity of the nerve. It is not always present, but, when present, is a most significant symptom. If the pus formation is rapid, especially at the base, optic neuritis is very likely to occur.

Consciousness is affected in various ways and degrees, from a slight stupor or delirium to maniacal excitement, passing into coma.

The course of the disease varies. It is sometimes rapid or fulminating. On the other hand, cases occur of infection of the membranes, as in otitis media, in which the duration is prolonged and marked by exacerbations and remissions.

PATHOLOGY.—In purulent meningitis the membranes, especially the pia-arachnoid, are thickened and opaque, and pus is diffused beneath them. This pus is observed especially at the base, but it sometimes also spreads along the lateral aspects, and may even be seen on the convexity. It often follows along the course of the blood-vessels, extending into the fissures, and appearing as white streaks. The underlying cerebral substance is usually somewhat involved, and may be softened, edematous, and broken down in places. Thrombi may form in the sinuses, and occasionally

engorgement of the veins on the outside of the skull is observed. The writer saw this condition recently in a case of infection from the sinuses of the nose. The collection of pus may be so great, especially at the base, as to present the appearance of a diffuse abscess, and in some cases an abscess cavity may form in the brain-tissue. When purulent meningitis arises from otitis media or from disease of the nasal cavities or orbit, the direct connection is usually easily traced, the inflammation having spread as from a center.

DIAGNOSIS.—It is not always possible to distinguish purulent meningocerebritis from brain abscess; in fact, as can readily be understood, the two conditions merge into each other. Solitary abscess, in which the pus is well walled off, is usually a more insidious and a more protracted disease, and the focal symptoms, such as paralysis and convulsions, are more marked. In diffuse purulent meningoencephalitis the onset is often acute and the progress rapid, focal symptoms are less marked, and the general symptoms, such as pain, fever, and delirium, are more pronounced.

Tumor of the brain is likely to simulate abscess rather than diffuse meningoencephalitis. The clinical history in tumor is different. The onset is insidious, the course slow, and the localizing symptoms more conspicuous. There is no history nor evidence of infection.

Cerebral hemorrhage occurs abruptly; pain and fever are not early or marked symptoms, and hemiplegia is usually seen from the beginning, except, of course, in the somewhat rare cases in which the motor regions are not involved.

Cerebral symptoms due to uremia may be simulated by this disease, but the history of the case, the condition of the urine, and the presence or absence of a focus of infection are the data necessary for differentiation.

Lumbar puncture may reveal the presence of pus or blood-cells in the cerebrospinal fluid in all cases of infection of the encephalon.

What we call meningeal symptoms in reality are not meningeal. In an acute case, a young woman had had fever and diarrhea for two weeks; coma developed, with slight trismus and slight contracture of the arms and exaggeration of the tendon reflexes. The legs were relaxed, the tendon reflexes abolished. There was no Kernig's sign nor trace of hyperesthesia or convulsions. Lumbar puncture released limpid fluid under considerable pressure. There was nothing to suggest poisoning, and the temperature kept very high. The woman died the third day after the onset of the coma, and necropsy revealed merely acute encephalitis without suppuration, as the only lesion accompanying the septicemia. Creyex (*Jour. de Méd. de Bordeaux*, Mar., 1918).

PROGNOSIS.—This is very grave unless the patient can be promptly relieved by surgical intervention.

TREATMENT.—There is no successful treatment for this condition with drugs. We know of no medicine that can control in the slightest degree the course of purulent meningoencephalitis. We are driven to palliative measures only, and even these do not accomplish much. Mercury and the so-called alteratives are useless. Opium, especially in large doses, only covers up the trouble for a time, and in advanced cases, with delirium and a tendency to coma, it is even dangerous. All other sedatives, such

as chloral, the bromides, and the coal-tar products, are of doubtful benefit. An **ice-bag** to the head may relieve pain, and it does no harm. Venesection, by bleeding or by leeches, is in no sense curative.

The one remedy is to get at and **evacuate the pus** as early as possible. In otitis media this is not infrequently done with success.

Three cases of suppurative meningitis operated upon with favorable results in 2. The surgeon should not hesitate to perform a radical operation in any case as soon as the diagnosis of an intracranial suppurative process is manifest. The site for **trephining** must be determined by the trauma or the ear affections, or possibly repeated puncturing by the Neisser-Pollack technique may be necessary to locate the best point. There is less tendency to prolapse of the brain when a considerable area is exposed than with a small trephine opening. In one case the author made 2 small openings and he thinks that this facilitated drainage. In both his cases there was oozing for a long time; even if merely the local exudation is drained away, this removes septic matters and prevents their spreading to adjacent regions. Kostlivy (Archiv f. klin. Chir., Bd. 79, 11ft. 3, 1912).

ACUTE HEMORRHAGIC ENCEPHALITIS.

Some observers have described a form of encephalitis to which they have given the above name. German writers especially have called attention to this disease, and Oppenheim says that the cause is always, or in most cases, some form of infection. Thus, influenza, measles, scarlet fever, typhoid fever, pneumonia, erysipelas, whooping-cough, mumps, and diphtheria have all been accused of causing this affection.

The disease is characterized by

multiple foci of congestion and by minute and even massive hemorrhages in the tissue of the brain. Infiltration of leucocytes, small emboli, and areas of necrosis are seen. The membranes, as a rule, are not involved. These lesions seem to point to the local action of micro-organisms or their toxins.

SYMPTOMS.—These are usually well marked, and consist of headache, vomiting, convulsions, delirium, and various paralyses. The constitutional reaction is pronounced; there are prostration and rapid pulse, but fever is said to be not always conspicuous. Coma supervenes, with rapid respiration and a tendency to death. Recovery has been claimed in some cases.

PROGNOSIS.—This is grave.

DIAGNOSIS.—The disease simulates meningitis, and, indeed, cannot always be distinguished from it. Moreover, the distinction is not of practical clinical importance. This complication of encephalitis may be suspected in cases of any of the infectious diseases named when grave cerebral symptoms set in.

TREATMENT.—This is entirely symptomatic. The attempt should be made to relieve pain, and to combat the rapid tendency to death.

ACUTE ANTERIOR POLIO-ENCEPHALITIS.

Strümpell has described an acute inflammatory process, localized in the motor areas of the cerebrum, which has been called acute anterior poli-encephalitis. The anatomical picture is not unlike that described in the preceding section. Infantile cerebral palsy may result from the affection. Some writers claim that this cerebral infection occurs occasionally in the

epidemic form of acute anterior poliomyelitis, but in the recent epidemic in New York not much appears to have been observed to confirm this view. According to some German observers, acute anterior polioencephalitis leads to cerebral sclerosis, a terminal condition which is sometimes found in the brains of children who have suffered with cerebral palsy.

SYMPTOMS.—These vary according to the location and extent of the lesion.

Hemiplegia, monoplegia, diplegia, and even paraplegia are the various types of paralysis observed, and in young children epilepsy, speech defects, and arrest of mental development are among the results. The paralysis is of spastic type, with exaggerated reflexes, and without true muscular atrophy.

ACUTE SUPERIOR AND INFERIOR ENCEPHALITIS.

Wernicke called attention to a very grave acute destructive process, which is localized about the aqueduct of Sylvius and the ependymal gray matter of the third ventricle. This form of acute encephalitis is claimed to occur especially in alcoholic subjects, but it also probably occurs from some forms of infection. In the region just named the disease is called *superior* polioencephalitis; but a similar acute affection occurs about the floor of the fourth ventricle, involving the pons and medulla, and is then called *inferior* polioencephalitis, and is practically an acute bulbar palsy.

In these various regions the gray matter, especially the nuclei of the cranial nerves, is involved, and the affection has thus some affinity with the process in the spinal cord called

acute anterior poliomyelitis. In the midbrain and pons, however, other areas are also sometimes involved, so that the clinical picture may include more than a mere nuclear palsy.

SYMPTOMS.—In the *superior* form the onset is often sudden and the course rapidly fatal. Delirium or stupor may occur, and the various muscles of the eyes are paralyzed, presenting various forms of ophthalmoplegia. Among other symptoms are nystagmus, optic neuritis, and even tremor, ataxia, and paralysis of the limbs. Articulation may be affected, and facial palsy has been seen. The pulse fails rapidly, and the tendency to death is marked. The prognosis is very grave, and the treatment must be sustaining.

In the *inferior* form of this disease we see an acute bulbar palsy, with paralysis of the lips, tongue, and muscles of mastication and deglutition. The extremities may be involved, the deep reflexes exaggerated, and respiration and the pulse accelerated.

These various forms differ according to the extent of the lesion. Symptoms are accordingly grouped in various ways. Prostration is likely to be extreme, and there is usually some febrile reaction. The paralyzed muscles are flaccid when the nuclei are entirely involved, and the electrical reactions are changed.

DIAGNOSIS.—The diagnosis rests largely upon the nuclear paralysis of the various cranial motor nerves; but, as already said, the process in some cases may be more widely diffused through the midbrain, pons, and medulla, in which case motor and sensory tracts may be affected as well as the nuclei of these nerves.

EPIDEMIC LETHARGIC ENCEPHALITIS.

This disease, observed in several countries during the great war, is particularly characterized by lethargic somnolence.

SYMPTOMS.—Observed by Netter (1918) the victim is seized with fever, headache, and at times vomiting. Almost immediately there is marked lassitude and somnolence. At first the patient can be momentarily roused from his slumbers, but later the condition passes into an actual coma, occasionally interrupted by delirium and restlessness. Very characteristic are the ocular disturbances, usually bilateral, consisting of ptosis, strabismus, immobility of the eyeball, or nystagmus. The intrinsic ocular muscles are less frequently involved, but paralysis of accommodation and a sluggish light reflex have been observed. The muscles innervated by the facial and those of the tongue, larynx, and extremities may participate in the paralysis. Tremor is not exceptional. The characteristic signs of meningitis, Kernig, rigidity, and pulse irregularity are lacking or but slightly marked. The meningitic line is, on the other hand, constant. Lumbar puncture yields a clear fluid, under normal pressure, without excess of albumin, and with a normal or but slightly augmented cell content. The mortality was about 50 per cent. Death or recovery may occur within a few days, but generally the disease persists through weeks or months. Lassitude and the eye disturbances continue for some time during convalescence.

The writer observed 7 cases. In all the diagnosis was manifest. Stupor,

however, varied in degree and was absent in one, a girl of 16; in her case there was the usual history of onset with headache, vertigo, and diplopia over about a week's time, together with at present third and seventh nerve palsies, much increase in tendon tone, and pronounced coarse tremor of the right extremities. Another patient, a man aged 35, has no emotional stupor, but lies curled up in bed complaining of headache. He is fretful and irritable. He vomits from time to time and presents inability to look above or below the horizontal and lacks the power of visual accommodation. The writer is convinced that these are cases of the disease described by Economo in April, 1917, in Austria; by Netter a year later in France, and at the same time by various British observers in England. Kennedy (*Medical Record*, Apr. 19, 1919).

ETIOLOGY.—While manifestly similar to epidemic poliomyelitis, lethargic encephalitis arises from a different cause. The symptoms cannot be held due to alimentary intoxication, *e.g.*, botulism. The cases always occur singly, whereas in botulism several members of a family become victims. An identical epidemic has been met with in Vienna. Wiesner thinks he has succeeded in transmitting the disease to the monkey by subdural inoculation and in isolating the causative germ as a Gram positive coccus. The disease must, like poliomyelitis, be propagated by germ carriers in good health or affected only with a slight catarrhal form. Probably injections of serum from convalescents, administered early, will here also prove of therapeutic service. Two previous epidemics are on record, one after the influenza pandemic in 1890, and one in 1895, in eight European countries and the United States.

The fact that the epidemic of lethargic encephalitis coincided in 1890 with the pandemic of influenza, suggests that it is a localization on the brain of the influenza virus. The disease has appeared anew in the last few months along with pandemic influenza. Both the encephalitis and the influenza commence with a similar onset of catarrhal rhinopharyngitis. It is identical with the disease known as *nona*, which was prevalent in Italy at the time of the last pandemic of influenza. Dragotti (Policlinico, Oct. 6, 1918).

All other forms of encephalitis should be distinguished from this "lethargic" type, before we can accept it as a new entity. One recalls further that Leichtenstein and Strümpell in 1892, called attention to the frequent grippal origin of acute hemorrhagic encephalitis. F. Raymond also has emphasized "that in epidemics of influenza some cases are encountered in which from the very first the patients present symptoms of acute encephalitis with the signs of grippal infection." Chartier (Presse Méd., Dec. 23, 1918).

PATHOLOGY.—Postmortem examination shows but little macroscopically; microscopically there are chiefly perivascular infiltrations, most marked about the nuclei of the motor nerves of the eye, in the pons, medulla, and gray substance of the ventricular walls. The spinal cord is but little involved. The lesions resemble those due to the trypanosoma of Africa.

Histologic findings in 2 cases given. To the naked eye the brain seemed normal, but the microscope revealed in both a small focus of subacute inflammation in the locus niger, spreading toward the ganglions of the base and to the gray matter close to the ventricle in the pons and bulb. The lesion was strictly limited to the juxtaventricular gray matter, the surrounding nuclei being apparently

sound. Marie and Tretiakoff (Bull. Soc. Méd. des Hôp., May 24, 1918).

MENINGITIS (PACHYMENINGITIS; LEPTOMENINGITIS).

DEFINITION.—Inflammation of the membranes of the brain. This may arise from various causes and is a symptom of various diseases. Thus there are purulent meningitis, tuberculous meningitis, syphilitic meningitis, and meningitis due to the pneumococcus. For more descriptive purposes it is usual to distinguish between inflammation of the dura mater, which is called *pachymeningitis*, and inflammation of the pia mater, which is called *leptomeningitis*. But practically the two membranes are often involved together.

Inflammation of the dura may occur as a septic infection, as in fracture or injury to the bones of the skull or in otitis media. It is then purulent. This condition is not easily distinguished from cerebral abscess and from purulent meningoencephalitis (*q.v.*). A distinct form is the *pachymeningitis hæmorrhagica* of Virchow, in which there is a hematoma of the dura, with the appearance of an organized blood-clot. It occurs especially in chronic alcoholics and the chronic insane. It is of vascular rather than inflammatory origin.

Inflammation of the pia mater, or *leptomeningitis*, likewise occurs from various causes. Thus there are tuberculous meningitis, epidemic cerebrospinal meningitis (see **MENINGITIS, CEREBROSPINAL**), and syphilitic meningitis. Various other forms are observed, but they are best studied in conjunction with the diseases in which they arise. Thus there is purulent meningitis (see **PURULENT CEREBROENCEPHALITIS**, in this article) and

there are meningitides due to the pneumococcus and other germs."

SYMPTOMS.—The symptoms are headache, vomiting, optic neuritis, fever, stiffness of the neck and back, rigidity of the limbs, and increased reflexes, followed in time by delirium, coma, convulsions, and death.

The vomiting in meningitis is peculiar in being generally unassociated with nausea and retching. In meningitis at the base of the brain it is observed with particular frequency. The headache is persistent and severe, and, though usually frontal, it may be referred over the entire head. Convulsions occur oftenest in tuberculous meningitis in children. Retraction of the head and neck rigidity are most pronounced where the basal meninges and, particularly, those of the spinal cord are involved. Optic neuritis is usually a late symptom. Other more or less common symptoms are ptosis, strabismus, contraction and later dilatation of the pupils, temporary pupillary inequality, and some of the characteristic phenomena of involvement of the trigeminal, facial, special sense, and cutaneous nerves.

In the majority of cases of metastasis to the head in visceral carcinoma, the skull and dura are simultaneously involved. In the minority the metastatic lesions are limited to the inner surface of the dura, the arachnoid, and the pia, with or without involvement of the brain tissue itself. Metastases in the meninges may either consist of small isolated tumors or, less frequently, exhibit a diffuse involvement, to which the name cancerous meningitis may be applied. In a case of the latter type cancer cells were easily found in the fluid obtained by lumbar puncture. G. Humbert and W. Alexieff (*Revue de méd.*, Dec., 1913).

DIAGNOSIS.—In addition to observation of the symptoms already referred to, knowledge of the existence in a given case of some antecedent condition commonly a cause of meningitis, *e.g.*, tuberculous disease, otitis, or pneumococcus infection, will not infrequently be of assistance in arriving at a diagnosis. Persistent headache, convulsions appearing only at a relatively late stage of the disease, and ocular involvement are features suggestive rather of true meningitis than of meningeal manifestations occurring in the course of a general infectious process. Lumbar puncture is frequently of great value in the diagnosis; through it the actual existence of a leucocytic reaction can be demonstrated and the particular micro-organism responsible for the disturbance ascertained by cultural and other methods.

Brudzinski's sign in meningitis is probably one of the best in the diagnosis of this disease, although it does not distinguish between the various forms. It consists of reflex actions manifested in what are called the neck sign and the leg sign and comprises two reflex phenomena, the identical reflex (*réflexe identique*) and the contralateral reflex (*réflexe contralatérale*).

The former is elicited by forcibly flexing the head on the chest, when the arms and legs are drawn up, to remain thus.

The contralateral reflex is produced by passive flexion of one leg, which causes the limb of the opposite side to draw up and remain in the same position.

In 42 cases of meningitis the author found the neck sign positive in 97 per cent.; the leg sign in 66 per cent.; Kernig's sign in 57 per cent., and the Babinski sign in 50 per cent. Northrup (*Jour. Amer. Med. Assoc.*, Jan. 14, 1911).

Animal inoculation in positive cases of tuberculous meningitis where bacilli have not been found produces tuberculosis in four to six weeks. Cytologic examination is extremely important. In tuberculous meningitis an excess of lymphocytes, up to 100 per cent., is noted. The gross fibrin content of the fluid after standing is a fairly constant guide, there being an increase in meningitis and little fibrin in normal fluid. Sophian (*Arch. of Pediat.*, March, 1911).

Ankle sign of meningitis found of diagnostic value. The ankle is grasped with one hand, the toes with the other, and the foot bent up toward the knee with a forcible push. When the phenomenon is not present the foot drops back again as soon as it is released, but in case of the pathognomonic reflex contraction the flexion persists. This ankle tonus is often in inverse proportion to the knee-jerk. It seems to be an exaggeration of the normal muscular tonicity, and was encountered in meningitis, sciatica, spastic tabes, and hysteria. L. Minervini (*Gaz. degli Ospedali*, July 11, 1911).

Diagnosis of meningitis made through the capacity possessed by the cerebrospinal fluid to inhibit in dog-blood the hemolysis induced by sodium taurocholate. This capacity is remarkably increased in meningitis, as was found constantly in 27 cases, with 37 normal controls. The test is positive long before cytodiagnosis is possible. Danielopolu (*Wiener klin. Woch.*, Oct. 3, 1912).

Meningism is analogous to peritonism without peritonitis. It comprises the meningeal syndrome: fever, stiff neck, hyperesthesia, headache, Kernig's sign, etc.; but the lumbar puncture is sterile. Nearly all acute infectious diseases show some percentage of meningism. That for scarlatina is 4 per cent. It sometimes occurs in helminthiasis, and a hysterical type is known. Meningism is usually recovered from cleanly and does not foreshadow

meningitis. The lesions comprise hyperemia and edema. The treatment is symptomatic. Kayser (*Berl. klin. Woch.*, June 3 and 10, 1913).

In the differential diagnosis of meningitis, brain tumor may at times give trouble, the more rapidly growing tumors being confused with acute leptomeningitis, and the more slowly, with the same process in a chronic form. Optic neuritis, however, is apt to be more pronounced and progress further in brain tumor than in meningitis, while symptoms such as pupillary inequality and strabismus are more suggestive of the latter than the former condition. Hysteria may be distinguished from meningitis by the absence of fever.

PROGNOSIS.—This is unfavorable, recovery being uncommon except in syphilitic meningitis, in which antiluetic specifics are applicable, and in epidemic cerebrospinal meningitis, in which serum treatment has considerably lowered the mortality.

Of 30 patients with pneumococcal meningitis, 4 recovered. Frequently repeated lumbar puncture not only permitted differentiation, but had a direct curative effect. The meningitis developed with sepsis and endocarditis in 20 per cent. of the total 30 cases; with otitis media in 10 per cent.; with disease of the accessory nasal sinuses in 30 per cent.; after trauma in 3 per cent., and with unknown primary localization in 10 per cent. Repeated, copious withdrawal of fluid by lumbar puncture is useful. The prognosis in pneumococcal meningitis, however, seems to be graver than in the epidemic form. Rolly (*Deut. med. Woch.*, April 27, 1911).

TREATMENT.—Surgical treatment is indicated in suppurative meningitis of otitic origin. Stacke regards lumbar puncture as the key

to successful treatment in cases of meningitis propagated from the middle ear by way of the labyrinth, and advises its performance whenever vomiting comes on in suppurative ear disease, especially if accompanied with vertigo, fever, or intense headache. Indeed, the **radical operation** is indicated, he states, in the presence of these symptoms even if the cerebrospinal fluid is found clear, and if the severe morbid manifestations do not promptly subside the labyrinth should be operated at once.

Elimination of the primary focus in the ear is the salient point in the surgical treatment of otitic meningitis. This involves the **opening of the labyrinth** in all cases in which either the functional examination before the operation shows that it is destroyed or the examination during the operation shows that it is diseased, the most frequent sign being the existence of a labyrinth fistula. To guard against the possibility of thrombosis of the sigmoid sinus, the author exposes the whole perpendicular part of the sinus and examines it. If puncture with a Pravaz syringe reveals fluid blood in two different places slightly apart, it is probable that there is no thrombus. If the syringe remains empty or if pus is extracted he does not open the sinus and expose the lateral wall during this stage of the operation, but waits to do it at the end of the operation, when craniotomy is performed, in order to avoid infection of the soft membranes of the brain from the diseased sinus, in case it should be found necessary to open the subdural space.

He performs **craniotomy** by enlarging upward the bony cavity produced by the radical operation, using as much as possible a strong cutting forceps and making an opening extending $2\frac{1}{2}$ inches horizontally and about $1\frac{1}{2}$ inches vertically. The opening should be so situated as to

expose freely for examination (1) that part of the dura corresponding to the mastoid antrum; (2) that part corresponding to the attic, for the inflammation of the soft membrane of the brain occasionally starts here as a local pachymeningitis, and (3) the part of the dura which covers the posterior surface of the petrous bone. Holger Mygind (Jour. Amer. Med. Assoc., Aug. 27, 1910).

The reports of intracranial involvement from nasal conditions are few as compared with those of otitic origin. In the literature only 56 cases have been reported as due to frontal sinus suppuration up to 1913, and since that date 5 more have been found. Meningitis complicating either chronic or acute sinusitis is most common in the male sex and during the second and third decades. Usually it runs a rapid course and terminates fatally in 5 or 6 days. Localized meningitis may be present for some time previous. The infection may be transmitted through a congenital or carious defect in the posterior sinus wall, through the veins or lymphatics, or by osteomyelitis. R. Butler (Trans. Amer. Laryng. Assoc.; Med. Rec., Oct. 2, 1920).

Where operative indications do not exist, the treatment of meningitis, except in the syphilitic and epidemic forms, can be little more than symptomatic. **Elevation of the head** and the application of **ice** to it are considered useful measures. As a derivative procedure, the use of **blisters**, applied to the back of the neck, is likely to prove of value, or **leeches**, placed either on the temple or behind the ear, may be employed. The patient must be kept in an absolutely **quiet** and preferably **darkened room**. A light, fluid **diet** should be given.

Headache may be combated with coal-tar drugs, such as **acetphenetidin**, and fever by means of **cool sponging**

or **bathing**. Arnold found that for continuous vomiting in protracted cases of meningitis administration of **hydrochloric acid** is very beneficial, morphine, on the contrary, aggravating this symptom by causing stagnation of the gastric contents. In several cases of infectious meningitis the same author observed that the epidermic use of **guaiacol** was followed by a diminution in the meningeal symptoms in a few days, with subsequent early recovery. Inunctions of **mercury** have long been considered useful in non-tuberculous meningitis cases. Relief of excessive intracranial tension by **lumbar puncture** has seemed valuable in a number of instances. In staphylococcic meningitis Churchill has used an **autogenous vaccine** apparently with complete success.

Early relief from excessive intracranial pressure by means of **lumbar puncture** is advocated by the author in the treatment of uncomplicated cases of all forms of meningitis, including tuberculous. Earliest possible recognition of pressure symptoms is required, for which purpose total and differential leucocyte counts are of value. Four cases of meningitis reported (including one tuberculous), which recovered after lumbar puncture. Hultgen (*Amer. Jour. Med. Sci.*, March, 1910).

Case in which a typhoid infection appeared to have settled exclusively in the meninges, typhoid bacilli being found in the cerebrospinal fluid obtained by **lumbar puncture**. The latter had an unmistakably curative effect on the meningitis symptoms. The author has collected 8 cases of typhoid meningitis in the literature. In all but 3 the patients recovered. Stühmer (*Münch. med. Woch.*, Feb. 14, 1911).

Influenzal meningitis is not a rare disease. All but 6 of 58 cases re-

ported have terminated fatally. Wollstein induced in monkeys a severe form of cerebrospinal meningitis by injection into the spinal canal of virulent cultures of influenza bacilli. An immune serum was then prepared from goats by repeated injections of virulent influenza bacilli extending over a long period of time, and it was found possible to rescue monkeys regularly from the fatal effects of the subdural inoculation of cultures of the influenza bacillus, through daily injection, by means of **lumbar puncture**, of the **immune serum** for three or four days. The author advises this treatment for influenzal meningitis in human beings in the same manner in which the serum for epidemic meningitis is employed. Flexner (*Jour. Amer. Med. Assoc.*, vol. lvii, No. 16, 1911).

In suppurative meningitis, that treatment may have any chance of success, it must be applied early and kept up energetically. As long as the affection is merely a diffuse seropurulent meningitis, repeated **lumbar puncture** and systematic administration of **hexamethylenamine** may cure. Henke (*Med. Klinik*, Feb. 25, 1912).

Case of pneumococcal meningitis in which 10 injections of **antipneumococcus serum** were given. The spinal fluid remained infected with pneumococci for some time after the last injection, but all the symptoms rapidly cleared up, and recovery followed. Cumming (*Lancet*, Nov. 9, 1912).

The cisterna magna is the one logical place where **removal of pyogenic cerebrospinal fluid** should be practised. The author has performed this operation 8 times. That all his patients died means simply that operative relief must be afforded at the beginning of the disease. If a patient presents head symptoms, a rising blood-pressure, venous engorgement and edema of the optic papilla, with absence of copper-reducing elements from the cerebrospinal fluid,

the disease is certainly septic meningitis. Death is inevitable unless relief be afforded by instant, free and continuous escape from the skull of the excess of cerebrospinal fluid with its content of bacteria and poisons. Haynes (Archives of Pediatrics, Feb., 1913).

Case of a 21-month-old child with slight neck rigidity and drowsiness. **Lumbar puncture** showed the presence of staphylococci. Two more lumbar punctures were made and from the last an **autogenous vaccine** was prepared, after a single injection of which the temperature immediately became normal and the child made an uneventful recovery. F. S. Churchill (Med. Rec., June 28, 1913).

Serous meningitis, described by Quinke, is characterized by involvement of the pia-arachnoid. The symptoms are mild, and are chiefly fever, headache, stiffness of the neck, increased reflexes, and occasionally optic neuritis. The cause is doubtful, but syphilis may be suspected and should be tested for.

Case of acute serous meningitis in an 11-year-old girl, at one time threatening immediate death. Two operations were performed to **evacuate** some of the **cerebrospinal fluid**, with excellent results. Axhausen (Berl. klin. Woch., Feb. 8, 1909).

When signs of meningeal irritation are particularly pronounced in dubious cases and the syndrome shows marked exacerbations with long remissions, the possibility of serous meningitis should be borne in mind. Under certain conditions a pulsating vascular murmur may be heard, similar to that of aneurism of the basal arteries. If the disturbances do not subside under **iodine** and **mercury**, **operative intervention** should be considered. The danger to vision should hasten the decision in such cases. Lumbar puncture alone seems to aggravate the condition. H. Oppenheim and M. Borchardt (Deut. med. Woch., Jan. 13, 1910).

Epidemic lethargic meningitis, described on page 594, seems to call for intraspinal injections of **convalescents' serum** according to Netter judging from results obtained in poliomyelitis. Marinesco suggests that they be made into the arachnoid cavity.

Experience in 4 cases leads to the belief that operative intervention in the hope of relieving intracranial pressure is contraindicated, for decompression cannot be beneficial when the tendency to further hemorrhage still exists. Aside from the features mentioned, the brains showed at autopsy small round-celled perivascular infiltration, capillary hemorrhages, ischemic softenings, neuroglial proliferation, chromatolysis, and coagulation necrosis. E. F. Buzzard (Lancet, Dec., 1918).

SPINAL MENINGITIS.

Inflammation of the membranes of the spinal cord may be located either in the dura or in the pia, or, as is not uncommon, in both. Syphilis is a common cause of meningomyelitis, in which either one or both membranes may be involved. Tuberculous meningitis is much more rare than the same condition in the brain, but the membranes may be involved in tuberculous spinal caries. Cerebrospinal fever is an acute infection, described elsewhere (*q.v.*). A purulent meningitis occasionally occurs from a septic focus, distant or remote, and spinal meningitis may be caused by the pneumococcus.

Chronic spinal meningitis presents the same symptoms, except certain minutiae, as tumors of the spinal cord. The cases occur in adults, and are characterized by pain and loss of power in the legs, with, it may be, also slight kyphotic curvature of the spine, and the ultimate development of a progressive para-

plegia running through the ordinary course and terminating fatally. The pain is felt in one limb to begin with, and then spreads to the other limb, and finally up the back. It is generally said to be in the substance of the limb, and feels in most cases like a tightening or drawing up. The typical girdle tightness is sometimes felt. The patients become paralyzed, a general sense of weakness coming on in the whole leg. As this is a chronic inflammatory condition, the prognosis depends upon the rule that if a patient is below middle life or at middle life recuperation is apt to be good; if beyond middle life, it is apt to be poor. The treatment consists in simple **laminectomy**, opening the theca, and washing it out with a **mercurial lotion**. There is no risk in using strong mercurial solutions, even up to 1:500, following up with a 1:2000 solution, and leaving in some of this strength when closing up the wound, which should be completely closed without drainage. It is not necessary to sew up the theca; by allowing the cerebrospinal fluid to drain away through the lymphatics of the walls of the wound, there is less tendency to subsequent headache, fever, and tachycardia. After the wound has completely healed, free **mercurial inunction of the spine** should be ordered, especially over the scar. Horsley (Brit. Med. Jour., Feb. 27, 1909).

HYPERTROPHIC PACHYMEINGITIS.

This occurs especially in the cervical region, and is usually caused by trauma. The dura is much thickened and the cord is involved. The symptoms, as was pointed out by Lloyd, closely resemble those of syringomyelia.

It is practically not possible in many cases to distinguish a pure meningitis from a meningomyelitis, or a leptomeningitis from a pachy-

meningitis. The various conditions should be studied in the various diseases which cause them, as in tuberculous meningitis, cerebrospinal meningitis, and syphilis (*q.v.*).

TUBERCULOUS MENINGITIS.

This is caused by an infection of the membranes of the brain by the tubercle bacillus. It is most marked at the base of the brain, where the membranes become thickened and opaque and an inflammatory exudate occurs. The affection is most common in children.

SYMPTOMS.—These may be divided into three stages:—

In the first stage there are headache, vomiting, constipation, slight fever, and a general decline in health, with slight mental changes, as irritability. The onset is insidious, but in some cases it may be abrupt. The headache may be accompanied by the so-called *hydrocephalic cry*, occurring especially during sleep.

In the second stage the disease is well marked. There are delirium, retraction of the head, fluctuating temperature, slow and irregular pulse, obstinate constipation, convulsions, optic neuritis, and various paralyses, as of the eye muscles, or even a hemiplegia.

In the third stage there are coma, weak and rapid pulse, sometimes a subnormal temperature, incontinence, and convulsions, and paralysis may persist.

DIAGNOSIS.—In the early stage the disease may be mistaken for infantile convulsions, gastrointestinal disorders, or a simple febrile attack. Later it may simulate pneumonia, typhoid fever, poliomyelitis, or influenza. It may simulate a few other

disorders, but the resemblance is slight. The distinction is to be made by the gradual predominance of the brain symptoms, and by eliminating the distinctive symptoms of such diseases as pneumonia and typhoid fever. Lumbar puncture may be of help; the fluid is generally only slightly turbid, but often contains small flocculi of fibrin; the cells are nearly all mononuclear, and tubercle bacilli can sometimes be demonstrated. In the second stage it is scarcely possible to mistake the disease.

Apart from epidemics of cerebrospinal meningitis, 70 per cent. of cases of acute meningitis in young children are tuberculous. Etiologically, 199 cases were divided as follows: Tuberculous, 138 cases; pneumococcic, 22 cases; meningococcic (sporadic), 24 cases; staphylococcic or streptococcic, 10 cases; influenzal, 4 cases; colon bacillus, 1 case. **Lumbar puncture** should be employed in every suspected case. In tuberculous meningitis bacilli are always present in the cerebrospinal fluid; although difficult to find in the early stages, in later stages a careful examination should discover them. The v. Pirquet test in most cases gives positive results. Holt (Amer. Jour. Dis. of Children, Jan., 1911).

TREATMENT.—The treatment is unsatisfactory, and can only be palliative at best, for there is no known remedy for the disease. The measures already mentioned in the treatment of other forms of meningitis are also applicable in the tuberculous variety.

Successful treatment of 2 cases of basal meningitis by **iodoform inunction**. An ointment was made up containing 15 grains (1 Gm.) of iodoform to the ounce (30 Gm.) of petrolatum, and rubbed thoroughly into the back and posterior part of the scalp, night

and morning. Small doses of **potassium iodide** and **bromide** were also given. H. Mowat (Lancet, Jan. 7, 1911).

The writers found in literature 38 undoubted cases of cured tuberculous meningitis, and 15 with doubtful diagnosis. Eliminating the latter, the treatment as shown by hospital statistics was 100 per cent. ineffectual, while intraspinal injections of **anti-meningococcic serum**, combined with frequent **spinal drainage**, employed in 1 undoubted and 2 doubtful personal cases of tuberculous meningitis all ended in recovery. Hollis and Pardee (Arch. Internal Med., July, 1920).

ENCEPHALOCLE.

This condition, also called hernia of the brain, or *hernia cerebri*, is either congenital or acquired.

The *congenital* form arises from defect in the development of the embryo, shown by failure of the walls of the cranial cavity properly to coalesce. An orifice remains, through which a portion of the brain or membranes protrudes. It is usually seen at the posterior base of the brain, and is sometimes associated with spina bifida. The cerebellum especially is then involved. Other locations are the root of the nose, the frontal suture, or even within the nose or mouth. In some cases the protruding sac contains only cerebrospinal fluid, and it is then called a meningocele.

The *acquired* form arises from injury to the cranium, causing loss of portions of the bones of the skull, thus resulting in an opening, through which a portion of the brain protrudes. It has been seen after fracture, and also after necrosis of the skull. The commonest cause is the operation of trephining. The procedure known as a decompressive operation, which is done for the relief

of pressure in cases, especially of brain tumor, is sometimes followed by a hernia of the brain. In a case of this kind under the writer's care a large hernia has protruded in the motor region, and has remained stationary for several years. (See also FUNGUS, OR HERNIA, CEREBRI, p. 171, Vol. V.)

The hernia is covered with the brain membranes and the scalp. These coverings may become very thin, and look as though they might rupture. Pulsation of the brain may sometimes be felt in the mass. Occasionally the tissues become inflamed, and even slough, requiring surgical interference.

The symptoms in some cases are only objective or even negative. In the congenital form, however, the condition is sometimes associated with other defects of development in the cerebrospinal axis. Pressure on the tumor in these cases causes temporary coma, paralysis, and other evidence of interference with the functions of the cerebrum.

The prognosis in congenital cases is bad, the patients seldom surviving more than a few years, or even months.

In the acquired form, especially after trephining, the symptoms are usually those that are due to the original lesion, such as trauma or tumor, rather than to the hernia itself. Cases vary greatly in this respect, however, and cannot be described here in detail. If the hernia should eventually lead to destruction of brain-tissue, especially in the motor region, corresponding symptoms would, of course, result.

VASCULAR DEGENERATION.

The blood-vessels of the brain, in common with those of the body gen-

erally, are subject to degenerative changes in their walls—the condition known as arteriosclerosis. The walls are thickened and become brittle, especially in advanced life. At the base of the brain, in the circle of Willis, and in the main trunks, these changes are often very marked. They are the causes of apoplexy, hemiplegia, aphasia, etc. The vessel either ruptures, causing a cerebral hemorrhage, or it is occluded by a thrombus, causing softening. (See CEREBRAL HEMORRHAGE, etc.)

Syphilis also causes thickening and degeneration of the blood-vessels. The inner coat is especially involved—the syphilitic endarteritis of Heubner. The resulting symptoms may be due to softening or hemorrhage, and are chiefly various forms of paralysis, as hemiplegia, monoplegia, aphasia, etc. (See also SYPHILIS and under the following heading: VASCULAR DISEASES OF THE BRAIN.)

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MENINGES AND BRAIN, DISEASES OF (CONTINUED).

VASCULAR DISEASES OF THE BRAIN.—The subjects of CEREBRAL HEMORRHAGE, ENCEPHALITIS, CEREBRAL ABSCESS, and HYDROCEPHALUS have been already treated, and hence need no further mention.

Cerebral vascular diseases might be considered as to their effects: 1. On the permeability of the vessel walls. 2. On the vasomotor arrangements for the brain itself. 3. On the brain tissue involved by vascular obstruction.

The main factor so far known regarding the vascular pathology of the brain hinges on the last one of these

points. Hence the best basis for approaching this subject is an outline of the effects produced by blocking of each individual vessel or branch. The causes and consequences will then admit of a more concise and satisfactory handling.

In general, it may be said that the effects are somewhat proportional to the size of the vessel and the suddenness with which the block occurs. Of course, as regards the eventual amount of anatomical damage suddenness has little to do.

GENERAL SYMPTOMATOLOGY.

Arteries.—(a) *The Dural Arteries.*—For two reasons, obstruction in these is harmless. In the first place, they do not have to do with the brain proper, but constitute in this particular an independent system. In the second, they are not terminal vessels, but are at all points protected by ample anastomoses.

(b) *The Brain Arteries Proper.*—The main factor here is the fact that, aside from the chief trunks, all the distributing vessels are more or less terminal arteries, and in part strictly so. Consequently the area supplied by any one of them is, in case of closure (embolism, thrombosis, obliterating arteritis, or enduring functional spasm), bound to undergo softening to a corresponding extent—the whole area, if a strictly terminal vessel, and a portion if only partially so.

The true terminal arteries are the perforants at the base and the small branches from the basilar directly entering the pons. But beyond the circle of Willis, all the pial arteries of much size are partially terminal.

The Individual Arteries and Branches.—*Lenticulostriate Artery*

(*One of the Preperforating from First Part of Sylvian*).—Partial softening in shape of a wedge with its tip in the interior part of the lenticular nucleus, while its base is directed forward and takes in the anterior two-thirds of the striate body. The wedge is formed of the anterior part of caudate, the internal capsule, and the third segment of the lenticular nucleus. Motor paralysis of the opposite side.

Lenticulo-optic Artery (also from Sylvian).—Softening of postexternal part of lenticular nucleus, of part of internal capsule, of anterior part of thalamus, and of tail of caudate.

Perforating Arteries from Choroid Plexus.—Partial softening of thalamus, size of a pea to a filbert.

Postexternal Optic Artery.—Walnut-sized softening in the subposterior part of thalamus and in the peduncle.

Precerebral plus Sylvian Artery.—Block at bifurcation of internal carotid, extending in the precerebral beyond the precommunicans. Softening of frontal, parietal, and sphenoid lobes, the striate body, etc.: *i.e.*, of the whole territory supplied by both the precerebral and medicerebral arteries. Here we may have opposite hemiplegia, and, if on the side of the speech-centers, “total aphasia, together with an altogether unusual amount of mental degradation, in addition to blindness and loss of smell on the side of the lesion. The extra mental degradation would be due to the fact of the cutting off of the blood-supply from the callosum, seeing that this is mainly supplied from the precerebral.”

Precerebral Artery Alone.—Softening of the frontal convolutions and of the inner surface of the hemisphere as far as the callosomarginal fissure.

Branches of the Precerebral.—1. *Subfrontal Branches.*—Softening of orbital convolutions. No distinguishing symptoms.

2. *Interior Prefrontal Branches.*—Softening of the first and of much of second frontal convolutions. Likewise part of so-called "silent" regions of brain.

3. *Posterior Branches.*—Softening of remaining median surface of hemisphere supplied by precerebral artery. Crural monoplegia.

(A) *Medicerebral Artery* (in its first 2 cm., from which part are given off the preperforatings above mentioned).—Softening of whole territory of Sylvian artery (same parts as in B); also motor segment of internal capsule, corpus striatum (thus including lenticular and caudate nuclei), and anterior third of thalamus. The symptomatology is also practically same as in B, except—if possible—more pronounced and with deeper mental impairment.

(B) *Sylvian Artery, Beyond the Perforatings, or all its Branches.*—Total softening of cortical territory of Sylvian (*v. infra*: branches). Blocking here causes complete hemiplegia of opposite side (with exception of the trunk and other bilaterally acting muscles) and "total aphasia" if on the side of the speech centers; "that is, in addition to aphasia proper there would also be agraphia, as well as complete word-deafness and word-blindness, carrying with them that amount of mental degradation which is inseparable from a blotting out of all the word centers in the leading hemisphere." Astereognosis and early apraxia may be added.

Cortical Branches of Sylvian Artery.—The clinical results here vary some

according to the slight variation in different individuals in the extent of cortex supplied by this vessel, but even more upon the differences in the freedom of the anastomoses existing between its branches (cortical) and those of the precerebral and post-cerebral.

1. *Subfrontal Branch.*—Softening of part of insula and of the subfrontal (Broca's) convolution. Aphasia if on the left side, without other paralytic complications.

2. *Prefrontal Branch.*—Softening of foot of medifrontal and part of precentral convolutions. Agraphia if on the left.

3. *Mediparietal Branch.*—Softening of both central convolutions along the Rolandic fissure, of the anterior portion of the first parietal convolution, and of the insula. In either of the last (Nos. 2 and 3) there may be aphasia due to cutting off of subcortical tracts, paralysis of face and arm on opposite side, and paresis of opposite lower extremity. Also paralytic agraphia, if on the left. Theoretically, according to Bastian, also loss of muscular sense in the fully paralyzed parts,—though impossible to demonstrate.

4 and 5. *Postparietal and Temporal Branches.*—Softening of the subparietal and supratemporal convolutions, and of part of the insula. Word-blindness and more or less complete word-deafness.

"It is only on rare occasions that vascular lesions are precisely limited to the seats of particular word-centers. They are much more frequently irregular in their distribution, or multiple, and thus give rise to confused or less typical forms of speech defect."

Postcerebral Artery.—More or less softening of the occipital lobe, especially the cortex on its inner and under aspects, including the region of the cuneus, the hippocampal gyrus, and posterior portion of lower temporal convolutions. Hemianopsia of the opposite half of the visual field, with preservation of pupillary reactions from both halves of the retinae.

Cerebellar Arteries.—Embolic and thrombotic softening here is more rare.

Vertebral Arteries.—Embolisms of the vertebral are more often on the left, due to the existence on that side of a marked constriction where the vessel discharges into the basilar, whereby emboli are caught at that point. Softening may not result. If, however, the block extends any distance along the artery (as is usually the case in thrombosis), softening in the corresponding half of the oblongata may be expected.

Basilar Artery.—Blocking of this vessel, usually thrombotic, so long as the postcommunicants are patent, only produces symptoms by cutting off the small terminal branches to the pons. These are, however, important, and two types of effect are distinguished according as the block affects the upper or lower portion. Where the focus is at the upper limits of the pons, involving cerebral crus, corpora quadrigemina, and optic tract, there may be a paralysis of the extremities on one side with that of the eye muscles on the other (hemiplegia alternans superior). Where, however, this affects the pons at the facial-nerve exit, there may be paralysis of the extremities on one side with that of the facial on the opposite side (hemiplegia alternans inferior).

EMBOLISM.

DEFINITION.—Embolism of the brain, like that in other parts of the body, is the blocking of an artery by a plug or material sufficiently solid to stop its blood-current. It plays a more important part here because: 1. The arteries are, to a greater extent than in most other parts, terminal vessels. 2. The special functions of any destroyed part of the brain cannot be compensated; as *e.g.*, in the lungs or spleen, where all portions act practically alike.

VARIETIES.—**Transient Embolism.**—In this form the occluding substance breaks up or is floated along to a place where the collaterals suffice, and this happens before death of the threatened tissues. It is believed to explain occasional transient seizures experienced by embolic subjects.

Simple Embolism.—The ordinary form, where the floating mass lodges in some artery and cuts off the whole current immediately.

Septic Embolism.—Where the embolic plug carries some infecting agent. Inasmuch as an ulcerative endocarditis may be due to the invasion of the ordinary pus-organisms (streptococci and staphylococci), gonococcus, tubercle bacilli, or even certain other micro-organisms, it follows that a plug carried to the brain may be the transporter of infection like that of its source. In such cases the reaction about the point of lodgment or in the involved area will bear some relation to the virulence of the underlying germ.

It is a notable fact that a septic cerebral embolism is far more liable than any other to form the starting-point of a hemorrhage. It seems to start from the eroded end of the vessel.

Aneurisms of the brain arteries in children are said to owe their origin to embolic processes.

Partial Embolism.—Where the plug, owing to its angular or irregular shape, does not at first completely block the vessel. In such case either it is soon driven along to some point where it does fully occlude the lumen, or a thrombotic deposit soon forms around it and thus completes the closure.

Symmetrical Embolisms.—The corresponding vessels on the two sides have, in rare instances, been the seat of embolism (both medicerebrals, in Carrington's case; both the medicerebrals and precerebrals on each side in Eisendrath's).

Pigment and Granular Emboli.—The collections of pigment in chronic malaria are well known. Globular hyaline masses have been described by Manasse, and are supposed to be derived from the white corpuscles. So far as concerns chorea, however, clinical and experimental studies have disproved the theory that it is due to multiple small emboli.

Fat Embolism.—This affects primarily the lungs, but in general fat embolism the brain arteries may also be invaded. Only in severe cases are serious brain symptoms produced, and fever does not result.

Two cases of cerebral fat embolism which presented similar symptoms and signs. They both had fractures of the thigh, in one case a comparatively simple fracture, and in the other two simple fractures, together with some crushing of the bones about the knee-joint and a lacerated and contused wound of the foot. The patients were both given chloroform for the setting of the fractures. Within about twelve hours both went into a comatose state more or less sud-

denly, without any previous noticeable pulmonary distress, the temperature rose rapidly, the pulse was of low tension and rapid, and there were no localizing signs in the nervous system pointing to a lesion in any particular part of the brain. Both might have been thought to be cases of cerebral compression if it had not been for the character of the pulse. One patient was trephined over the right side because he had evidence of injury to the skull on that side. The authors do not believe that the operation hastened death, the only cause of which that could be demonstrated was fat embolism of the brain. The other patient recovered to a slight extent from what seemed to be an almost hopeless condition, and his death was, no doubt, partly due to secondary bronchopneumonia; in this case also some of the typical signs of cerebral compression were absent. Godlee and Williams (*Lancet*, Apr. 22, 1911).

Case of fat embolism of the brain in a robust young man who had both femurs broken in the caving in of a mine. There was little shock and he seemed to be doing well for twenty-four hours; then he became somnolent and succumbed in coma the third day. Autopsy revealed the cerebral form of fat embolism. The sufferer had dragged himself some distance from the scene of the accident to give the alarm for 4 buried mates, and he was taken by train to a hospital in town.

After any fracture all manipulation and transportation of the injured should be reduced to the minimum, for fear of inducing fat embolism; it is better to refrain even from changing the dressings too often and in lifting and carrying the injured there should be as little shaking up as possible to avoid favoring absorption of fat from the site of the lesion. The writer has known of instances in which the cerebral symptoms developed during or shortly after the patient had been moved. Weber (*Med. Klinik*, May 25, 1913).

Air Embolism.—The same applies as to fat embolism. This refers only to cases where the air enters at other points in the body.

There is also the possibility of air entering through the brain vessels; but this applies not to the arteries, but to the veins and sinuses. In Genzmer's case air to a fatal extent was aspirated through the opened longitudinal sinus. François-Franck's experiments appear to show that by way of the vertebral veins air may be taken in through the occipital diploë veins. In the Porter case there was some evidence that air was introduced into brain-vessels in tetanic convulsions, the wound being across the forehead. Koerner concludes that in operations on the lateral sinus, where the sinus-wall shows respiratory movements, the vessel should first be closed below before venturing to open it, lest air be sucked in.

SYMPTOMS.—These are largely dropping out of functions (*ausfall symptome*) rather than strictly positive. They are, as a rule, though not invariably, those of a sudden interruption of function of the portion of the brain involved, sudden in onset and promptly complete in effect. Rarely they deepen for hours after the onset. They necessarily vary in intensity and kind according to the extent and location of the area supplied by the vessel. Certain immediate effects may pass off, and some of the more lasting manifestations may gradually ameliorate.

There are no focal premonitions (as headache, dizziness, unilateral tinglings or numbness about the body, paresis, etc.), and previous headaches, apparently in relation to the trouble, count against embolism.

Aphasia speaks in general more for embolism than for hemorrhage, though common enough in the latter also. Development of the condition during sleep makes the probabilities against embolism.

A history of past rheumatism, especially the presence of a heart murmur, and still more a knowledge of previous vascular plugging (in any part of the body) are strongly suggestive of embolism. To fully warrant the diagnosis, we must establish the existence of some source, as valvular disease or endocarditis at the time of the seizure, though various pulmonary and other conditions may suffice.

The occurrence of apoplexy or hemiplegia in persons under 40 years of age has been supposed to indicate embolism, though there are too many exceptions to allow much value to any such age rule.

The occurrence of coma argues against embolism; at least, embolism limited to the pallium is not attended by this symptom, and this is its most common location.

The focal symptoms are those of the part involved, and may include almost any loss of function seen in brain disease, though they are more often those of the left side of the brain. For the regional diagnosis (localization) these have been given in brief outline in the schedule of arteries.

ETIOLOGY.—This has been given in part under the heading VARIETIES.

The forms of verrucous and ulcerative endocarditis, yielding vegetations or other solid fragments that may become freed from their base, are the best-recognized causes of embolism. It has been found that embolism of the brain occurs in 5 per cent. of cases

of valvular disease, and that this occurs twice as frequently in females as in males.

Rheumatism, gonorrhea, chorea, scarlet fever, appendicitis, and septic processes of all kinds in whatever part of the body, by their tendency to endocarditis, are indirect causes of embolism. Destructive pulmonary processes, pleural irritation, and enteroperitoneal troubles may start and free thrombi that find lodgment in the brain.

PATHOLOGY.—The main feature is the softening, and this involves all tissues so far as it goes. It may be red, white, gray, yellow, or brownish, dependent on circumstances, duration, etc. "In the early stages of embolism or thrombosis of vessels supplying the cortex, red or red and white softening mixed is found in the area affected; after longer periods yellow softening is met with, or what French writers term *plaques jaunes*, and, after much more prolonged periods, pseudocysts are found, owing to complete atrophy and absorption of the cerebral tissue having taken place."

It is still an open question whether all focal softening of this type is due to vascular blocking. If so, then in numerous cases either the obstructing material has disappeared or the trouble has been an arterial spasm of sufficient severity and duration to produce the same effect. The left side, and especially the left Sylvian and its branches, is the more frequent site.

PROGNOSIS.—Experience shows that the prospect of late improvement after embolism is as good as after cerebral hemorrhage. In favorable locations a certain amount of col-

lateral compensation occurs, so that a marginal zone of endangered tissue recovers a sufficient degree of supply to resume function. Moreover, many of these are young subjects in whom some substitution of function is still possible. Immediate danger to life occurs only when the area involved is great, or where essential centers in the pons are included.

TREATMENT.—The treatment of this condition is in most respects the direct opposite of that for cerebral hemorrhage. Our chief usefulness is at the time of the attack; by immediate and active measures, then, great good can be accomplished.

An ideal method would be the development of a collateral circulation. But the brain arteries are so largely terminal vessels as to preclude full compensation where an artery of much size is stopped.

Where the blocking is due to atheromatous or other soft material, it may break up sufficiently to pass on. We can only aid this by increasing the blood-pressure and tumbling the plug along.

The most available and useful way for us is to force the embolus as far along into some peripheral vessel as possible. This is accomplished by **placing the head low**, giving free libations of **hot and stimulating drinks**, applying **bandages to the extremities or abdomen**, and the administration of **nitroglycerin** or **amyl nitrite**. **Strophanthus** may be admissible if the heart is not acting so tumultuously as to possibly tear off another plug.

The patient should be in the fully reclining position, with the head low. All depressants, depletors, and such vascular constrictors as **ergot** and

digitalis should be most scrupulously avoided.

The management of the case after the embolic softening has fully developed is that of hemiplegics in general. We may not remove the focus, but we can look after the general health and do much, by training the patient, to regain full power of what is left.

THROMBOSIS.

DEFINITION.—Under this general heading it is convenient to include the blocking due to specific autochthonic coagulation, arterial disease, obliterating endarteritis, etc. To some extent these are distinguishable conditions clinically and therapeutically, yet they have much in common. In this sense it includes all cases where local processes or disease conditions lead to vascular occlusion and thus to the production of symptoms, if any are present. While there may be a wide difference in the origin of these cases, the final stroke usually depends on a local coagulation or deposit of material from the blood. If the vessel be previously narrowed, then, of course, much less will suffice to block it.

VARIETIES.—There is, in the first place, a wide distinction between arterial and venous thrombosis.

Arterial.—This presents several subforms:—

1. One is due to conditions of the blood favoring the formation of clot (leucocytosis, increase of coagulation ferment), as in chlorosis and the puerperium; or to a thickening of the blood and slowing of its current, as in certain diseases attended by debility and exhaustion.

2. Due to trauma, ligature (as in Marchand's case, where fatal throm-

bosis of the Sylvian artery extended up from a ligation of the carotid), adjacent inflammations, and encroachments or compression, as by neoplasm. The traumatic cause may be either operative or accidental. According to Gerhardt, thrombosis in the branches of the Sylvian artery may occur in tuberculous meningitis and thus account for the hemiplegic symptoms in some of those cases.

Otherwise this form is so rare as to merit merely enumeration. The causes of both Form 1 and Form 2 act even more frequently to produce sinus thrombosis.

3. That due to syphilitic arteritis. Here the progressive narrowing of the arterial lumen at length reaches such a degree as either to cut off directly the blood-current or to slow it so that coagulation occurs.

4. The atheromatous and allied changes in the arterial wall found in the aged, acting in much the same way as the specific form. Arteriosclerosis with or without nephritis might be supposed to favor thrombosis, but the accompanying increase in blood-pressure serves largely to prevent this; hemorrhage is the far more frequent result. Gout and rheumatism are favoring antecedents.

SYMPTOMS.—In general, these are gradual in onset and for a time progressive in character. In contrast to this is the fact that there are no prodromata in embolism and at least much less tendency to them in hemorrhage. The age, general condition, and personal history of the patient are all-important aids in the diagnosis.

Loss of consciousness is not the rule in thrombosis, or not until the condition is so far advanced as to approach a fatal ending. There is a

tendency to a slowing of the pulse. It may, however, vary considerably from time to time, and may increase, of course, if there is any complicating sepsis. This slowing occurs, no matter what part of the brain is especially involved, though, doubtless, it is more pronounced when the basilar is the seat,—and there is a possibility that in all cases where present it is due to participation of that vessel.

Fever is not an accompaniment of the thrombotic process in itself, and occurs only secondary to some outside inflammation or to septic disintegration of the thrombus itself. Barring sepsis, there is, on the contrary, an inclination to subnormal temperature, though this feature will take an irregular course. "Yawning, and especially sighing, at times in respiration are frequent and noticeable symptoms in thrombosis and its precedent conditions, though also common in advanced cerebral hemorrhage." Apoplectic motation, so common in progressing brain hemorrhage, is here absent.

The fact that compression of the carotids may aggravate existing symptoms and even bring on slight convulsions in persons suffering from impairment of the brain circulation, especially thrombotic plugging of the basilar (Griesinger's syndrome), has suggested it as an expedient in the diagnosis of thrombosis. But as it affects disadvantageously the patient's cerebral condition, and possibly involves injury to an old person's carotids, it is generally discountenanced.

Occasionally, in persons of some intellectuality, it is quite possible to locate the trouble in the field of one or more arteries, preferably the Syl-

vian or its branches (for which purpose compare the schedule of arteries above given).

In the autochthonic form (due to overcoagulability of the blood, retardation of the current, etc.) there may be no distinct forerunners, but only a progressive increase in symptoms and severity. This developmental stage may be very short if the process is limited to a single vessel, or may steadily increase to a fatal termination if it extends to other vessels, for the conditions which started the process may continue to extend it. "Aphasic and amnesic defects of speech have been met with occasionally during or after acute specific diseases, or during the puerperal state, and in all such cases a thrombosis, partial or complete, of the left cerebral artery is the most common cause" (Gerhardt), though the same causes may favor embolism.

In the other two chief forms we have a history of past syphilis, the evidence of advanced arteriosclerosis, or a senile subject usually advanced in years to give us a distinct clue. Here prolonged and wavering prodromata, especially if diffuse or scattering and not focal, strongly suggest thrombosis. There are frequently such warnings and forerunners of various kinds. Transitory paresthesiæ (tinglings, numbness, etc.), pareses, aphasic spells, twitchings, headaches, visual obscurations, cardiac and respiratory irregularities, lapses of memory, mental hebetude, dizziness, etc., according to the location and extent of the threatened area, are more or less frequent. If unilateral in type, they are the more in evidence. These, at times, last over a period of weeks or months, but

often are of a few days' or less duration. "The physiologically recurring waves of vessel contraction and diurnal or other periods of fall in blood-pressure, added to the pathological narrowing of the vessel (where there is danger of thrombosis), may evidently, for a time, limit the nourishment of the respective area sufficiently to impair its function without actually causing necrosis. The tissues are still supplied with enough to keep them alive, and as soon as the flow again increases these resume their functions. Presently, however, if relief is not obtained, the matter goes too far, and irreparable softening ensues." In some of these cases conditions of *astasia-abasia*, *dyslexia*, etc., are noticeable. In reading, writing, muscular or other effort there is a quick tiring of function. "The centers act normally for a brief period, then fag out." This may apply to large areas or almost the whole brain; it is more often one-sided or even further limited.

Some authorities claim that the specific form is usually limited to a single vessel or a few branches, and hence is focal in character, but to this there are certainly many exceptions. In the senile type, however, the process is widely distributed, and hence the manifestations are more general and diffuse. This applies more especially to the prodromata and general features than to the symptoms following the softening,—which latter necessarily represents one or more distinct foci.

"In the specific form, which may occur at almost any period of life, there may, or oftener may not, be much headache; if especially nocturnal, so much the more in evi-

dence." Ophthalmologists recognize a *chorioretinitis syphilitica* as analogous to specific diseases of the brain arteries. In suspected cases lacking a definite history of syphilis a careful search must be made for any marks about the body or other indications pointing or not to that diagnosis; Wassermann tests, or an excess of leucocytes in the spinal fluid, may give confirmation.

ETIOLOGY.—Certain general influences play a secondary rôle. All debilitating and wasting diseases, by weakening the circulatory force and by reduction of the traversing fluid, have such a tendency. Excessively warm weather, a rapid rise in the atmospheric temperature, and marked fall of the barometric pressure favor the occurrence of thrombosis, while opposed to cerebral hemorrhage. Senility also acts in the same sense, as well as in a more direct manner.

The more immediate causes fall under two heads:—

1. Local disease of the vessel walls. Atheroma, pre-eminently a disease of the old and favored by chronic alcoholism, occupies a prominent place here. It narrows the lumen of the vessel, but may also be the object around which the thrombus starts. Syphilis acts essentially by thickening of the arterial wall (*endarteritis syphilitica*, *periarteritis nodosa*, etc.); it is said to cause thrombosis chiefly in those between 20 and 50 years of age.

Sometimes the thrombosis starts in an aneurismatically dilated artery.

2. It may be due to a strong tendency of the blood to clot (*leucocytosis* often present). This is a much less frequent cause. Gout, chlorosis, and especially the *puerperium* (when the

vessels of the uterus have to be closed by clot) here play a rôle. In such case a practically spontaneous coagulation occurs and obstructs an otherwise healthy vessel.

PATHOLOGY.—This is, from a practical standpoint, simple, and corresponds closely to that of embolism. Inasmuch, however, as the remaining vessels are so often more or less similarly diseased in the common forms, the chances of establishing an adequate collateral circulation are not as favorable. Consequently the area of softening, for any given vessel, is rather larger. So soon as the current has been entirely cut off for a short time, a few hours or probably less, necrosis is established and the part thus affected is hopelessly lost. The later course of such a focus is the same as that after embolism.

PROGNOSIS.—This has reference to three points:—

1. The prodromal stage. Where it is possible to make the diagnosis and institute treatment at this stage, softening can usually be headed off. This is quite intelligible in syphilis, though there is a great tendency to recurrence. And even if the specific process is absorbed, there remains ever after a weak spot in the arterial parietes that may under strain give way and be the source of a hemorrhage. The senile gouty and atheromatous forms are also amenable, and not infrequently seem to recover permanently. Of course, in that happy event it is not to be supposed that the artery wall is rejuvenated, but only that things have so adjusted themselves that there are no longer active manifestations.

2. The thrombotic softening. This in itself is, as above stated, somewhat

less favorable than in embolism. The tissue loss is permanent, and function can be compensated only to a degree.

3. The tendency of the process to extend. It is difficult to be very explicit on this point. In many cases there is reason to think that numerous vessels are more or less affected by the same process and that the same dyscrasic cause continues, only that it reaches extremes in but one or two at a time. Unless very carefully managed, we may expect that sooner or later the danger limit will be reached in some of these.

TREATMENT.—To be successful this must be prophylactic and directed to the prodromal stage. The trouble is of slower development than hemorrhage or embolism, and needs be met with less vigor, but more persistence and greater skill in adaptation of means to an end. There is one danger in the measures for relief: we are dealing with diseased vessels, their walls being often much weakened; there is no such disturbing fear in embolism, for there the vessels are presumably healthy; nor in hemorrhage, for there our efforts at relief involve no strain on the vessels.

When we find signs of such danger impending, the first or immediate line of treatment is analogous to that in embolism, though there is less need of increasing the body fluids. The vessels must be dilated to allow the blood to pass, and the pressure should be increased to get it through. Here, again, the **nitrites** are as yet our mainstay, sometimes reinforced by **strophanthus** and **strychnine**. We desire the slow, continuous-acting nitrites; Bradbury found experimentally that there was a difference in

this respect. In the practical use of the nitrites, however, there is one point not duly appreciated. From **nitroglycerin** we rarely get any stomach disturbance; but from nitrite of sodium and, though less, also from erythrol tetranitrate there is very often complaint of much discomfort about the region of the stomach, and it is the same in whatever way administered. The objection to these latter remedies is time and again so great that they have to be discontinued. Still, even then we can fall back on the nitroglycerin and succeed fairly well. **Alcoholic stimulants in small amounts and diluted** give wonderful temporary aid, when not otherwise contraindicated.

Avoid digitalis and everything causing arterial contraction.

As soon as immediate relief is secured a course must be adopted looking to more lasting benefit.

For arteriosclerosis small, long-continued doses of **iodide of potassium** are much used. The modern non-saccharated solution of **hydriodic acid** is usually more satisfactory; 5 to 10 drops of the dilute form, well diluted and after meals, can be given for considerable periods and tend less to iodism.

The nitrites should be accompanied or followed by **brucine** (in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain—0.003 to 0.006 Gm.) or its allies in stout doses, and persisted in for months with more or less regularity according to immediate needs at any time, unless forbidden by high systolic pressure.

Another useful line of remedies depends upon the fact that most of the old patients are rheumatic, gouty, or sufferers from what might be termed **senile lithemia**. Physical inactivity

plays a part. **Waste and refuse products of the system are not eliminated with due promptness and cause or aggravate the arteriosclerotic trouble.**

Here **alkalies, antilithic remedies, and salines** have to be employed. Much aid is furnished by certain of the **sulphur-waters**. If it is possible for the patient to visit the springs, so much the better; otherwise the waters may be employed at home. A course of these waters can be repeated from time to time.

In sudden cerebral lesions a gouty state is common, and generally presumable, because age imperfection of the organs generally leads to an approximate condition and justifies some **lithium** or **potassium**, combined with a diuretic, **spirit of nitrous ether** and **spirit of juniper**, to which some **digitalis** may be added—more if thrombosis is suspected than if hemorrhage is probable. The opposite rule should obtain with an aperient. If a clot has formed, only gentle action of the bowels should be secured; if a vessel has ruptured, an active purge is wise, such as **croton oil**, to lower the blood-pressure. **Salines** alone, it should be remembered, seldom act well in the horizontal posture; they need the aid of gravitation. Blood should be drawn to the extremities.

If there is reason to regard the lesion as thrombosis, little more can be wisely done. We have no practical agent to reduce the coagulability of the blood. **Citric acid** is said to have this effect, and may be given as lemon juice in plenty of water. When hemorrhage may be confidently diagnosed, the treatment should be such as to increase the tendency of the blood to clot. Salts of **calcium** have this effect, and may be given in whatever form can be most promptly obtained. If the lactate or chloride is not at hand, common chalk may be converted to a soluble salt by any suitable acid that

is available. **Arsenic**, by hypodermic injection, has a similar effect, and $\frac{1}{16}$ grain (0.01 Gm.) of the **arsenate of sodium** may be given in a few drops of water. There is no reason to believe that small doses of **iodide of potassium**, which are constantly given at the early or later stage, exert the slightest influence.

But one measure is imperative in every case of either kind—**physical tranquillity**. It should surely be superfluous even to mention this, but experience shows, too often, that it still needs to be insisted upon. Even in the slightest case, if the patient must be moved, it should be as little as possible, and he should be absolutely passive. Gowers (Brit. Med. Jour.; Therap. Gaz., Nov. 15, 1907).

In the syphilitic form the whole power of our therapeutic resources should be promptly brought to bear and continued until all symptoms are well in hand. It should be borne in mind that often the so-called specifics will develop this desired local action only after the vessels have been dilated. So long as they are almost closed, it is evident that little blood, and consequently little of the medication, can reach the imperiled point. It is necessary, if possible, to open the vessel path, and, while keeping the way open, follow up with the more direct specifics.

THROMBOSIS OF THE BRAIN VEINS AND SINUSES.

Veins.—Primary thrombosis of brain veins has been but rarely observed. Hence, despite the occasional description of cases in the literature, it is impossible to present anything very systematic in regard to the matter.

Without doubt it is of greater frequency than appears from the above. The reason why it is not more recognized is that in itself it but very ex-

ceptionally causes symptoms. All the pial veins have numerous and free anastomoses, so that serious stasis only results when whole networks of contiguous veins are filled. In the latter event softening of the corresponding drainage area has been noted. In such a case a focal diagnosis is the most that one might expect to make. If other manifestations are present, they are usually due, as in sinus trouble, to sepsis rather than the thrombosis as such.

The question of terminal veins in the brain is not fully decided, though only as regards the perforatings, the prefrontal efferents, and parts of the internal or Galen's system: the same parts, it may be remarked, where the arteries are strictly terminal. The balance of evidence favors the view that in these limited sections there are at least many connections between the finer branches. The practical facts as regards Galen's system will, however, be summarized in discussing the straight sinus.

More often there is a secondary venous thrombosis here, an extension backward of a like process in the sinus into which the vein empties.

Cretefaction and fatty degeneration of the parietes of these vessels also occurs, though, of course, without clinical significance, and the same applies to the endophlebitis deformans chronica described by Huber.

Sinus Thrombosis.—This is a blocking of any one or more of the several venous sinuses of the brain.

Such obstruction is, of course, never of embolic origin, but always due to thrombosis (or, in rare cases, to trauma or ligature). Neighboring septic trouble is more often a cause than in the case of the arteries, but

otherwise disease of the vascular wall plays no such part as with the arteries. The causes are, however, many. In children it occurs in marasmus, cholera infantum, whooping-cough, and other conditions of extreme exhaustion. In the adult, chlorosis, pregnancy and the puerperium, erysipelas (by extension, centrally, of a process starting at the surface), cholera and like disorders that greatly reduce the body fluids, septic processes in adjacent tissues, and any form of debility that greatly weakens the circulation. Most frequent of all the cases of phlebitis of the lateral, petrosal, and connecting sinuses, due to extension of inflammation from ear disease; the important features of this form belong to the ear section.

There are other less frequent forms of inflammation, starting, perhaps, in the parasinoidal spaces and involving the sinuses.

SYMPTOMS.—It should be remembered that one or both jugulars may be tied, one or even both lateral sinuses closed, or almost any single sinus blocked without the necessary production of symptoms, as has been many times shown by clinical, operative, and, in animals, experimental evidence. The only exception to this is the straight and possibly the two cavernous sinuses. In the very young, the feeble, or those otherwise exhausted, blocking of a sinus may have more effect, and be a factor in a general breakup. Such was, perhaps, the explanation in Kummer's case, where a fatal result followed ligation of one internal jugular, some hyperemia and hemorrhage being found in the brain.

The sinuses that are easy of access

surgically are the longitudinal and the two laterals. Besides these, if warrantable, it would be quite possible to tie the end of the straight sinus.

Thrombosis of the brain does not lead to any definite increase of the cerebrospinal fluid, as a rule. The only exception is where the outflow through the straight sinus is interfered with, or, possibly, the venous discharge from the small fringe of choroid plexus in the angles of the fourth ventricle.

For the most part, the symptoms attributed to sinus thrombosis are really due to the attendant sepsis or an extension of the inflammation to neighboring structures. Consequently it is only incumbent here to consider the cases where positive symptoms are due to the blocking as such.

It is claimed by Voss that a murmur can be detected in the unobstructed internal jugular vein, or that it can be produced artificially by a slight pressure of the stethoscope on the neck close to the base of the skull. If, however, the murmur is absent despite such reinforcement, while present on the other side, there must be occlusion of the sinus.

The presence or absence of a sinus pulse has no diagnostic value as regards thrombosis.

The untoward effects of closure of the straight sinus are as follows:—

In cases of closure of the sinus rectus, Galen's vein, or the velar veins, three possible outcomes are to be thought of:—

1. Full physiological compensation. There appears to be no evidence to show that perfect compensation can occur.

2. An increase of ventricular fluid, leading to hydrocephalus.

The ample anastomoses described, and the fact that normally this venous current has to turn several sharp angles before leaving the skull, make it, at first, unintelligible why there should ever be any trouble following the closure of the sinus rectus or its practical extension, the single trunk of Galen's vein. And, *so far as concerns either the vitality of the tissues or the function of the brain substance and nerve substance proper, there is nothing to show that compensation is less perfect than where other brain veins are closed.*

The difference depends entirely on the presence, in the territory of this vein, of a peculiar structure, the choroidal tissue, occurring only in the brain ventricles. This tissue normally produces ventricular fluid. Its activity is easily influenced by many conditions, and it responds quite naturally to any interference with the venous discharge by an increased production of fluid.

It is, then, not primarily any venous stasis that causes symptoms, but only the secondary hydrocephalus. And the facts show that this is always bound to occur. This causes death, if at all, only after a lengthy period and in this indirect manner.

3. Early death.

If, however, the velars be closed (*i.e.*, the venæ intimæ be cut off from both their regular and collateral outlets), then, so far as present evidence goes, a speedy fatal ending is inevitable. This takes place before there is time for the development of much hydrocephalus, a small quantity of blood-tinged fluid being all that has accumulated.

It is still possible that if only the main trunk of one or both velars was obstructed, and the thrombus did not

extend into any of their branches, the fatal ending might be delayed, but hardly for long.

Cavernous Sinuses.—In some cases simple blocking of a cavernous sinus may not cause marked symptoms. It depends upon how much of a *confluent* it happens to be in the individual case. Even when it receives a large basilar and a deep Sylvian branch, it is probable that other venous channels can re-establish an outlet and softening be avoided. The most definite symptoms are on the orbital side. There may be puffiness about the orbit, some distention of the veins in the same region, and even prominence of that eyeball or more lasting interference with the vision and nutrition of that eye. But all such manifestations are far more marked in septic than in simple thrombosis.

TREATMENT. — Where the thrombus is of septic origin or has become infected, **surgical treatment** is called for, the same as in any other part of the body. There is no safety or recovery until the material is removed. In cases of simple or uncomplicated thrombosis, on the other hand, direct interference is not called for; prophylaxis, if anything, is the *desideratum*.

WILLIAM BROWNING,
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MENINGITIS, CEREBRO-SPINAL.—The first authentic report of this disease in America dates back to 1806, and was made in Massachusetts. Judging from the record of mortality, no epidemic has been of so severe a type as that of 1905-06 in New York City.

Cerebrospinal meningitis was epidemic in New York in 1871-72. The

fulminating type predominated, and existed among the negroes. This epidemic continued until 1874, when it spread throughout the United States. In 1876 the disease appeared sporadically, and remained so until 1893, when a severe epidemic occurred. The disease again remained in its sporadic type until the severe epidemic of 1905-07. Since that time sporadic cases have appeared during the fall, winter, and spring months of the year.

A peculiar feature of this disease is that but a small proportion of the population is infected. When physicians and nurses are directly exposed they rarely contract the disease. During the four large epidemics in New York City the morbidity was as follows:—

1872	8.07 per 10,000
1881	3.70 per 10,000
1893	2.67 per 10,000
1904-05	6.30 per 10,000

Flügge estimated that during an epidemic fully 70 per cent. of the people living adjacent to meningitis patients are *carriers* of the meningococcus. These carriers have this pathogenic bacterium in the nasopharynx.

The disease was prevalent during the cool months in the camps of all the fighting nations. The carrier rate was carefully studied by the English in the civil and military population in both the endemic and epidemic forms. Two to 5 per cent. were found infected where the disease was endemic. In one garrison the carrier rate increasing as winter approached until it reached an extraordinary height in December. A rapid succession of cases tended to increase the virulence of the meningococci. To check the spread of the disease: 1. The individual soldiers were protected as

far as possible from infection by suitable ventilation and floor space, the elimination of carriers detected by cultures, and cleanliness both in the individuals and their surroundings. 2. Prophylactic injection of meningococci killed by a low heat or suitable antiseptic was used experimentally both in animals and man with apparently favorable results. Only a serum known to be polyvalent was used for treatment. 3. Disinfection of carriers was attempted on a very large scale with considerable success. The best results were obtained where the carriers entered rooms filled with a very fine spray. Zinc sulphate in 1 per cent. solution and chloramine-T in a 1 or 2 per cent. solution had given the best results. Anterior and posterior nasal sprays had also been used with some success. W. H. Park (Trans. Assoc. Greater N. Y.; N. Y. Med. Jour., Nov. 2, 1918).

In 1905, 2775 cases were reported to the New York Board of Health. Sixty-seven per cent. of these cases occurred in children under 10 years of age, and 15 per cent. in infants under 1 year of age. While a large number of cerebrospinal meningitis cases are reported to the Board of Health very many cases of a milder or abortive type are not reported. Registration of cases is not compulsory; frequently cases are reported as simple spinal meningitis or tuberculous meningitis which may or may not have been abnormal types of cerebrospinal meningitis.

In 1906, at the height of the epidemic, there were reported 1032 cases, with 812 deaths, in greater New York. In 1907 there were 828 cases reported, with 624 deaths. Thus, the mortality in 1906 was 78.7 per cent., and in 1907, 77.5 per cent. During the six months of 1908 there were reported 253 cases, with 182 deaths, the mortality being thus 71.9

per cent. Therefore, it may be stated that the mortality averages between 70 and 80 per cent.

During the great war, the year 1915 seems to have been a record one for this affection in France and England. In the zone of war activities in France the number of cases was 1073 and in England the incidence was 2566. Less than half the English cases occurred in soldiers. (Pathologia, cited by Med. Record, Jan. 11, 1919).

SYMPTOMS.—During the epidemic in New York 3 classes of cases occurred, mild, abortive, and severe.

Mild Type.—Slight fever, generally malaise, and perhaps vomiting.

Abortive Type.—This type is usually seen in strong children, who are able to withstand a severe infection. By reason of their health they are less severely infected, as shown by their relatively mild symptoms and the rapidity of their convalescence.

Differences between sporadic and epidemic cerebrospinal fever. The sporadic cases are often so mild that the intermittent or remittent febrile symptoms, headache and drowsiness, are the only ones that lead to a thought of cerebrospinal fever. The rigidity, the hyperesthesia, Kernig reaction, herpes, delirium, and gradually increasing hydrocephalus, as evidenced by the so-called Macewen sign, are usually present, but we rarely encounter the severer symptoms of the disease—sudden and abrupt unconsciousness, petechiæ or diffuse hemorrhages, and paralysis. Cerebrospinal meningitis of a meningococcic type resembles pneumonia as seen in adults in the sporadic and epidemic form. Koplik (Med. Record, Oct. 3, 1908).

The onset is usually sudden, and I have seen meningeal symptoms subside within ten days with no sequelæ. This happened in the case of a child with undoubted cerebro-

spinal meningitis in which the diagnosis was confirmed by bacteriological examination of the spinal fluid. Rhinitis with catarrhal discharge from the nose is sometimes an early symptom in this disease; it is frequently found in the abortive type of the disease. The danger attending the presence of the meningococcus in the nose consists in the ease with which this pathogenic bacterium can enter the frontal sinus and thus give rise to encephalitis.

The writer noted epistaxis in 4 out of 12 cases. In the first 3 the attacks determined an immediate improvement of the symptoms. In this particular epidemic the mortality was comparatively low, viz., 25 per cent. In only 1 case was antimeningococcus serum employed, so that it looks as if the low mortality were due to the epistaxis. The cases may be classified as follows: Meningitis without epistaxis, 8, with 3 deaths, 37.5 per cent.; meningitis with epistaxis, 3, with no deaths. L. Rimbaud (Med. Press and Circ., Sept. 7, 1910).

In the abortive type of the disease there frequently is a nasal discharge in which the *Meningococcus intracellularis* can be found long after the rhinitis has disappeared. The ambulatory cases are the ones which disseminate this infection, because they carry the pathogenic bacteria from house to house.

The meningitis may commence with a slight coryza and a coryza may develop after the disease. No measures are known which will effectually clear the air passages of the germs. Epidemic cerebrospinal meningitis is comparatively frequent in infants and is peculiarly difficult to diagnose in them, as the onset is usually very insidious, commencing merely with torpor and symptoms of indigestion. R. Debré (Annales de méd. et chir. enfant., April 15, 1911).

Severe Type.—In the severe type there is a sudden onset of symptoms. In older children a distinct chill is usually the first symptom noted. The skin feels hot. The temperature rises to anywhere between 102° and 105° F. (38.8° and 40.6° C.) in the rectum.

The writer observed a case in which the temperature by rectum registered 109° F. (42.7° C.) by 3 different thermometers. A lumbar puncture brought a few drops of a turbid spinal fluid. Fifteen c.c. of **Flexner's serum** was given. Four hours later the temperature was 103.4° F. (39.6° C.). The patient, a baby, recovered. Manning (N. W. Med., Oct., 1920).

The pulse may be slow or rapid; the respiration irregular, sometimes sighing and labored, but most frequently Cheyne-Stokes in character. Later, there are vomiting, pain in the head,—in the frontal or occipital regions,—and pain at the back of the neck. There are moaning and frequently delirium. Vasomotor disturbances, such as the flushing of one ear or one cheek, are occasionally seen. The *tache cérébrale* is usually noted upon stroking the breast with the finger-nail, a distinct hyperemia following, which remains for several minutes.

The tendons are very sensitive to the slightest pressure. The patellar reflexes are usually absent. When the thigh is flexed on the abdomen and we try to extend the leg there is considerable latent contraction,—the so-called *Kernig sign*. This symptom alone should not be depended upon. Hyperextension of the great toe produced by stroking the sole of the foot—the so-called *Babinski reflex*—is not always present; it is fre-

quently noted in perfectly healthy children. In a series of 50 children I examined, the Babinski reflex was found in 40.

Brudzinski's neck sign in tuberculous and other types of meningitis is present in 100 per cent. of those ill with either cerebrospinal meningitis or pneumococcal meningitis. The technique in eliciting the neck sign is as follows: The head is forcibly flexed with the left hand while the child is lying flat on its back; with the right hand pressure is meanwhile exerted on the chest to keep the child from being lifted. If the sign be positive, both legs will flex on the thighs and the thighs on the abdomen. The identical "collateral sign" consists in flexing the leg on the thigh and the thigh on the abdomen, when if the sign be positive the opposite lower member will assume the same position.

According to Parmele neck rigidity was practically universal in the 230 cases treated at the Kansas City General Hospital in 1912.

At the General Hospital No. 6, Fort McPherson, Ga., in the winter of 1917 and 1918, the cases showed no uniformity of symptoms or signs. The most uniform, however, were headache, 100 per cent.; fever, 80 per cent.; delirium, 60 per cent.; vomiting 60 per cent.; Kernig, 50 per cent.; opisthotonos, 30 per cent.; orthotonos, 20 per cent. No cases presented the hemorrhagic spinal spotted rash, but possibly the early administration of serum prevented it. Early diagnosis is often possible only by lumbar puncture, especially in cases of fever and delirium with no other physical signs. Camac and Bowman (Arch. Int. Med., Jan., 1919).

In normal cytology of the cerebrospinal fluid the number of lympho-

cytes varies from 0 to about 7 per cubic millimeter. In any meningeal irritation, acute or chronic, the lymphocytes increase in number; they may do so indefinitely, up to thousands per cubic millimeter. Examining a number of cerebrospinal fluids from infants, Kaplan found that in the tuberculous forms the lymphocytes predominate. In the other acute meningitides of children the polynuclears and lymphocytes were equal or nearly equal in number.

It is marvelous how readily the polynuclears diminish if a patient shows the slightest tendency to improve, and how, on the contrary, they increase as the inflammatory process grows worse. *Pari passu* with the polynuclear increase the Fehling reaction disappears. This point is extremely important, as there are a number of cases of tuberculous meningitis in which the tubercle bacillus cannot be found even if the antiformin or the Jousset method be used. In these instances the copper-reducing substance in the cerebrospinal fluid is considered as highly suggestive of the tuberculous nature of the meningitis. Non-reduction of the Fehling solution, or the appearance of a violet color change instead, is significant, in Kaplan's opinion, of the non-tuberculous nature of the affection, unless a mixed infection exists. In case a double infection is demonstrated microscopically the invader that has the upper hand in the infection is usually reflected in the behavior of the cerebrospinal fluid with the Fehling solution. If it be the tubercle bacillus, reduction will occur; if it be another organism, it will not. The latter occurrence is due

to the fact that the organism has produced a marked increase in the polynuclears, which are in some way responsible for non-reduction. The importance of cerebrospinal fluid examinations in pediatrics needs no emphasis.

Either constipation or diarrhea may be present. The bladder acts well, although enuresis may exist. In some cases there is a marked retention of urine.

Contrary to conditions observed in other infections, the urine is clear and abundant, with an exaggeration of the elimination of nitrogen and phosphates at the height of the disease. The subsidence of the temperature under the influence of the serum does not always mean that the disease is conquered; the proportion of nitrogen in the urine may remain high, showing that the disease still has the upper hand, and that it is necessary to keep up the serum until the amount of urea in the urine begins to decline. Galebert and Thubert (*Revue de méd.*, March, 1910).

The joints are usually swollen, simulating rheumatism in such cases. There is also a distinct petechial eruption in some cases. In a series of 22 cases seen by me 6 showed distinct petechiæ; in 6 others the skin showed a distinct eruption resembling that of scarlet fever. Owing to the spots present in this condition, the disease was frequently termed "spotted fever." The pupils are usually dilated; sometimes they are irregular. I have seen cases—during the epidemic of 1905—in which one pupil showed marked dilatation, while the other was contracted almost to pinpoint size. Strabismus is a frequent symptom. Occasionally one notes nystagmus. Photophobia is common; in one of my cases the

child cried whenever a lighted candle was brought near the eyes. Opisthotonos is usually present. The severe rigidity of the sternocleidomastoid muscle, added to the marked rigidity of the arms and legs, forms a very prominent symptom during the course of the disease. Owing to these severe contractures, one usually notes constant moaning, very probably induced by the pain occasioned thereby.

Symptom of cerebrospinal meningitis that he has not seen noticed in the literature of the disease, viz., analgesia, or partial or complete anesthesia of the conjunctiva and cornea. The writer has found this sign in fully one-half of a large number of cases seen by him in the Municipal Hospital at Philadelphia, even in patients who were perfectly conscious in some instances. E. Burvill-Holmes (Jour. Amer. Med. Assoc., Jan. 25, 1908).

The only early constant diagnostic sign is a relative rigidity of the neck. A clear spinal fluid indicates a bad prognosis. The temperature is a misleading criterion as to the state of disease. Wesson (N. Y. Med. Jour., April, 1913).

The writer has observed an erythematous rash very early after the onset, and before there were any symptoms of meningitis to suggest the diagnosis. In one case where the patient was under observation from the onset, there was a profuse rash to be seen 6 hours later, which disappeared 4 hours after it had first been observed.

In the second case the erythematous rash was present 12 hours after the onset and had almost disappeared 6 hours later. Symonds (Lancet, July 21, 1917).

SEQUELÆ.—After no infectious disease do blindness and deafness remain as permanent injuries oftener than after cerebrospinal meningitis.

These conditions can be prevented in many cases by neutralizing the toxin early in the attack. When the diagnosis is positive no time should be lost, but serum immediately injected.

DIAGNOSIS.—Upon an early diagnosis largely depends the outcome of a given case of cerebrospinal meningitis.

Statistics of final diagnosis of cases reported to the New York Board of Health. A very large percentage of error is shown. The original diagnosis was confirmed in 48 of the total of 247 cases. Tuberculous meningitis was found in 75 and streptococcal, pneumococcal and influenzal meningitis in 9, 2, and 3 cases, respectively; these last named could hardly have been differentiated except through lumbar puncture. Thirty-seven cases turned out to be infantile paralysis, mainly of the encephalitic type. Thirty-six cases, including 19 of pneumonia, were probably called cerebrospinal meningitis on account of the symptoms of neck rigidity and Kernig sign. P. L. DuBois (Jour. Amer. Med. Assoc., March 15, 1913).

If symptoms present themselves from which a suspicion of meningitis arises, lumbar puncture should be performed and about 5 to 10 c.c. of fluid withdrawn to establish the diagnosis.

With proper technique, no danger attends tapping of the ventricles or of the subdural space. In many cases the spinal fluid is turbid or opaque, and this has given rise to the teaching that turbid fluid means cerebrospinal meningitis, while clear fluid means tuberculous meningitis. This is not always true. Flexner calls attention to cerebrospinal meningitis in its early stages in which the spinal fluid is clear, yet contains the *Diplococcus intracellularis*.

A study of 250 cases in Camp Jackson suggested that the disease was primarily a general sepsis, the meninges being secondarily involved. The writers thus learned to recognize it in the premeningitic stage, characterized by general systemic symptoms, lasting from a few hours to a few days, in 40 per cent. of the cases. These symptoms were a temperature rarely above 102°, slow pulse, with vagal irritability. The manner and facial expression of the patients were characteristic; they were dull, apathetic, resented interference; they used the least possible amount of effort to answer questions, the voice was low, and they quickly lapsed back into quietness. The face, and especially the ears, showed cyanosis; the secretions were viscid; the tongue, when protruded, was covered with sticky saliva. The upper respiratory tract was frequently involved; a petechial rash usually appeared very suddenly. In milder cases there was a papular rash like that of chickenpox; there was a lack of balance of the deep reflexes, one side showing an exaggeration, while the other showed a normal, diminished, or absent reflex. A lumbar puncture usually revealed a clear fluid with meningococci. W. H. Herrick (Trans. Amer. Med. Assoc., Med. Rec., June 29, 1918).

The diagnosis of established cerebrospinal meningitis is, as a rule, easily made. The sudden onset of meningeal symptoms, associated with vomiting, suggests scarlet fever, but examination of the throat shows an absence of patches, the so-called "scarlatinal diphtheria" or "scarlatinal necrosis." The tongue is usually coated, but has not the strawberry appearance so common in scarlet fever.

In a series of 86 cases of epidemic cerebrospinal meningitis the condition most frequently present was rigidity of the posterior cervical muscles. Vomiting and headache were

very constant features, but muscular pains were only present in about one-fourth of the cases. Kernig's sign was present in over three-fourths of the cases. An herpetic eruption was present in 14 cases, a petechial eruption in 16 cases, and an erythematous in 21 cases. Direct examination of the fluid drawn off by lumbar puncture showed meningococci in 26 out of 75 cases, but cultures showed the specific organism in 70 per cent. of the cases. Watt (Lancet, Aug. 22, 1908).

A positive diagnosis of the disease can be made by examining the fluid drawn by lumbar puncture. As a rule, the spinal fluid is turbid or opaque—not clear and transparent, as in tuberculous meningitis. The characteristic *Diplococcus intracellularis meningitidis* described by Weichselbaum is always present. In a few cases the streptococcus and the pneumococcus have been found, but these are the exception. The bacteriological diagnosis, according to Weichselbaum, depends on the fact that the diplococcus is Gram-negative. It is important to remember that the *Micrococcus catarrhalis* is frequently found in the nasal passages; great care must be exercised to differentiate it, both in its relation to Gram staining and also as to its morphological characteristics.

In old people this disease presents a distinct type. The principal differences are the slow beginning of the disease, with prodromal symptoms, a tendency to vomit and headache, early cloudiness of the sensorium, the increased frequency of the pulse inclined to a still greater increase, and, as a rule, much lower temperature than is usual in epidemic cerebrospinal meningitis. Most marked is the slight degree of stiffness in the neck, while Kernig's symptom is always present early. Herpes is not

present. This disease is not at all common among old people. Reiche (Münch. med. Woch., Sept. 7, 1909).

The characteristic symptoms of acute onset, convulsions, and high fever, and the classical signs of rigidity of the neck and Kernig's sign, do not usually appear in the meningitis of very young infants, excepting very late in the disease. Kernig's sign and rigidity of the neck are absent in from 50 to 60 per cent. of the cases under 2 years of age. Strabismus, usually fleeting, and pupillary inequalities are among the most constant signs of the disease. Hypersensitiveness, especially of the legs, is a cardinal symptom, as also are the pupillary dilatation from pain, on pinching the spine, and a reflex tremor of the whole body or of a group of muscles on setting the child erect or moving its limbs. This tremor, however, usually presents itself during or after the fourth week of the disease. Highly important from the diagnostic viewpoint are alterations in sight or hearing, such as blindness or deafness, following an illness of uncertain nature. In infants a widening of the fontanelles is of great diagnostic value, as showing increased tension of the cerebral fluid. This is often an early sign and a common condition in epidemic meningitis. Ventricular puncture is important in diagnosing all cases showing increased tension of the cerebral fluid, as the cocci are often found here when they are absent in the spinal fluid. Lumbar puncture is essential; but as this means is not always available, and a bacteriological examination requires time, a provisional diagnosis at least should be made from the symptom complex, so that treatment by serum injection may not be delayed. E. Levy (Med. Klinik, Bd. vi, S. 1569, 1910).

As for the differential diagnosis of cerebrospinal meningitis, the phenomena to be borne in mind as characteristic of the latter are:

vomiting, fever, anorexia, constipation; pupils irregular and do not respond properly; photophobia; opisthotonos, Babinski present, tache present, Kernig present, Oppenheim present; convulsions throughout the disease, and Brudzinski present.

Tuberculous meningitis is the one disease with which epidemic cerebrospinal meningitis is most liable to be confounded. The writer notes the following points of differentiation: In the epidemic form the onset is sudden, while in the tuberculous type it is slow. Temperature, eyes, and pulse are about the same in each disease. The temperature in the tuberculous variety may correspond more nearly to the tuberculous type of fever. Neck symptoms, Kernig's sign, spasm of the extremities, and paralysis are more marked in the epidemic form. Cerebral pressure, as shown by the fontanelles, is more marked in the epidemic type. There is a high leucocyte count in the epidemic type, while there is a low count in the tuberculous variety. We have the history of an epidemic in the one variety, and a history of tuberculosis in the other. In the epidemic variety the cerebrospinal fluid is turbid and contains polymorphonuclear leucocytes in excess, and meningococci. In the tuberculous type the fluid is clear and contains lymphocytes in excess and tubercle bacilli. W. M. McCabe (So. Med. Jour., April, 1909).

In *fermentative gastritis* there are manifest: vomiting, fever, anorexia, constipation; pupils regular and respond to light; opisthotonos absent, no Babinski, no tache, no Kernig, no Oppenheim; the condition may be ushered in with convulsions; Babinski absent.

Another disease with which cerebrospinal meningitis may be confounded is *scarlet fever*. Thus, the following symptoms may be found in

both conditions: Vomiting, fever; mild exanthematous eruption; accelerated heart action, and convulsions during the period of incubation. On studying such symptoms one can note many points in common. Still, the trained eye will at once examine the tongue, which is characteristic in scarlet fever, and which may not even show swollen papillæ in meningitis. In the throat the necrotic, dirty-gray patches, on the tonsils

Technique of Lumbar Puncture.—The child is placed on either side with the spine curved,—this position spreading the vertebræ apart,—in such position that the convexity of the arc formed by the vertebræ is directed toward the operator. Either the space between the third and fourth or that between the fourth and fifth lumbar vertebræ may be chosen for the puncture. An imaginary line drawn through the crest of the ilium



Lumbar puncture made between fourth and fifth lumbar vertebræ.

especially, will be found in scarlet fever, but will be absent in cerebrospinal meningitis. The cervical glands will be swollen and easily palpable in scarlet fever, but not in cerebrospinal meningitis. As a rule, patients with cerebrospinal meningitis cry continuously because of pain. There is usually marked opisthotonos, which is never found in scarlet fever. The pupils show irregularity and sometimes photophobia in cerebrospinal meningitis; in scarlet fever these symptoms are never found. Rhinitis with catarrhal discharge is sometimes an early symptom in this disease.

to the spine affords an easy indication for locating the proper site of puncture.

In making a puncture one should use a needle having a caliber sufficiently large enough to allow the fluid to flow freely. The needle is inserted along the upper border of the spinous process of the lower of the two vertebræ chosen, in a direction almost horizontal and at an inferior angle of 10 degrees to the axis of the spine. It penetrates from 2 to 5 cm., according to the age and development of the child, before the canal is reached,—which can usually be determined by a slight lessening of re-

sistance. The stylet should then be withdrawn. If the fluid does not escape through the needle it should then be withdrawn slightly and the stylet reintroduced to dislodge any obstruction in the lumen. The puncture should be made as simply as possible, laceration of the tissue around the vertebral column and bleeding due to lateral movements of the needle being carefully avoided.

For diagnostic purposes 15 to 20 c.c. should be withdrawn if the fluid is watery and clear. If it is turbid, then the more one withdraws, the better. I have withdrawn as much as 60 c.c.

If the *Diplococcus intracellularis* is found in the spinal fluid, it is important to withdraw as much of the fluid as possible. The site of the puncture should be closed with a strip of adhesive plaster. Strict asepsis must be observed throughout the operation.

The condition of "dry tap" so frequently encountered may be caused by one or more of the following factors:—

1. The caliber of the needle is small and the spinal fluid very thick.

2. Adhesions are present at the base of the brain, preventing the passage of fluid from the ventricles to the subarachnoid space.

3. A successful puncture having been made, a dry tap may follow because of inflammatory adhesions the result of the previous introduction of the needle.

4. Closing of the foramen of Magendie is the most frequent result of the inflammatory process, and results in dry tap.

5. A fibrin clot, or the presence of the cord in front of the needle, may

prevent the outflow of the cerebrospinal fluid.

If a dry tap is noted, one should leave the needle *in situ* and introduce a second needle two spaces lower. If sterile water be injected through the upper needle and then observed to flow out of the lower needle, the needle point is known to be in the spinal canal. The spinal cord in infants terminates at about the level of the lumbar vertebræ. As already stated, introduction of the needle is simplest between the third and fourth or the fourth and fifth lumbar vertebræ. In these interspaces there is no cord; hence no injury can follow. An imaginary line drawn through the crests of the ilia corresponds to the fourth lumbar intervertebral space.

Crohn's apparatus is useful in determining the exact hydrostatic pressure of the spinal fluid. In some cases the pressure is unusually low, while in others it is very high, the latter condition being met when a large quantity of liquid is present.

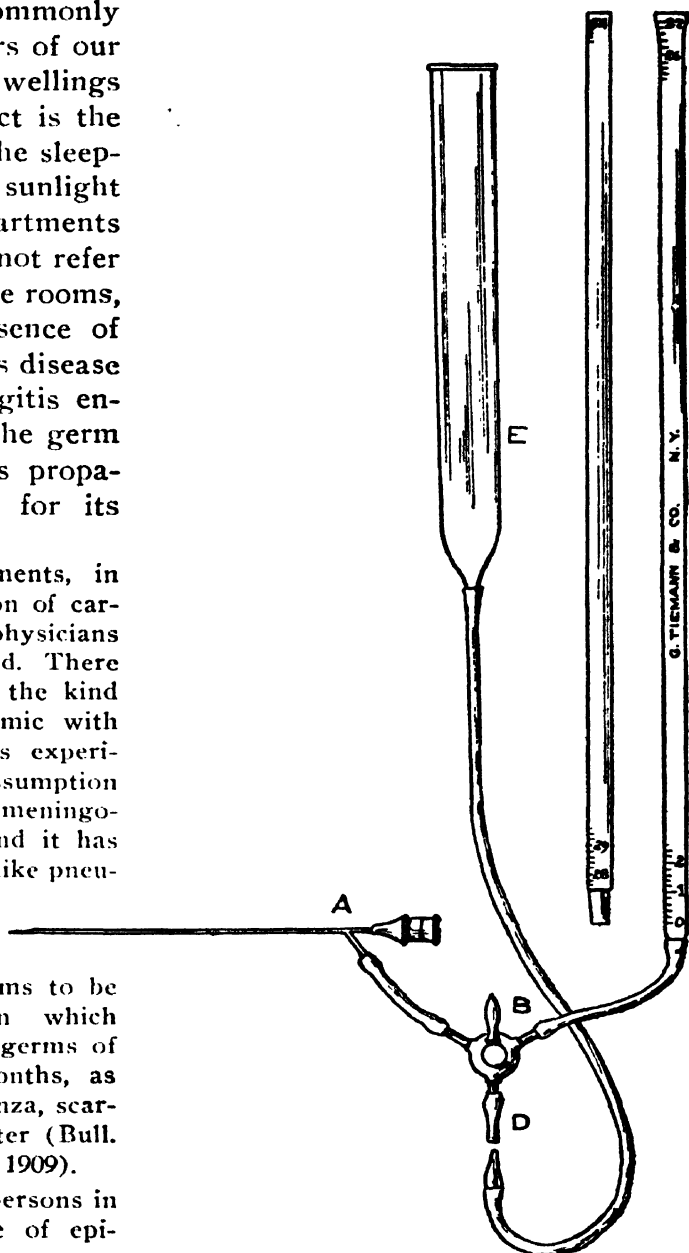
ETIOLOGY.—During the severe epidemic of the winters of 1905 and 1906 the weather was unusually cold. The precipitation of snow and the amount of frost and ice were far greater than the average in the corresponding zone for many years. With the exception of the two winters associated with this epidemic there had been occasional spells of mild weather in the winter months, which permitted ventilation in the humblest homes. During intense cold such as characterized these two winters, however, people insist upon closing windows and doors tightly, especially when fuel is expensive. The air in some of these houses is stifling, and, especially among the

ignorant, it is impossible to persuade those dwelling in them to admit fresh air. Living in such insanitary dwellings is certainly a factor in causing the general depression so commonly seen in the congested quarters of our large cities. A feature of dwellings in the tenement house district is the total absence of sunlight in the sleeping apartments. Direct sunlight never enters the sleeping apartments in many of the homes. I do not refer to the absence of light in some rooms, but in particular to the absence of sun rays. When an infectious disease such as cerebrospinal meningitis enters such congested homes, the germ finds a favorable soil for its propagation and most especially for its dissemination.

In well-ventilated apartments, in hospitals, etc., the proportion of carriers is very small, and physicians and nurses are rarely attacked. There was only a single case of the kind in the recent Silesia epidemic with 3700 patients. The writer's experience has confirmed the assumption that the patients retain the meningococci only a short time, and it has also shown that meningitis, like pneumonia, displays a predilection for the winter and spring months, the maximum in March. There seems to be something in the season which exalts the virulence of the germs of these diseases in these months, as also possibly those of influenza, scarlet fever, mumps, etc. Netter (Bull. de l'Acad. de Méd., May 4, 1909).

Fully 25 per cent. of the persons in the environment of a case of epidemic meningitis carry the germs without presenting signs of illness. In a schoolroom, for instance, where one of the children has had meningitis a fourth of the children will be found to harbor the meningococcus in the nasopharynx. The diffusion of the germs is more marked the lower

the hygienic level of the environment; in hospitals the carriers are very few. R. Delré (Annales de méd. et chir. infant., April 15, 1911).



Crohn's apparatus for determining the pressure of the cerebrospinal fluid.

The *Diplococcus intracellularis meningitidis* of Weichselbaum has usually been found the causative agent of this disease. In some cases a strep-

tococcus, in others a pneumococcus, has been found. Weichselbaum believes that the meningococcus is frequently present, lying dormant in the crypts of the tonsils and pharynx, and, therefore, that when lowered vitality exists, because of subnormal conditions, the meningococcus gains access through the lymph-channels to the meninges and sets up an acute and sudden infection. In addition to the presence of the meningococcus in the tonsils, this pathogenic microbe is frequently found in the nose, whence it probably gains access through the frontal sinuses to the brain.

The meningococcus can be transmitted and an infection disseminated by direct contact with secretions containing it. Weichselbaum does not believe that the sudden appearance of a case of cerebrospinal meningitis in an otherwise healthy locality is extraordinary when the etiological conditions, *e.g.*, the possibility of harboring this diplococcus in the nose and throat, are remembered.

Where, in the examination of military garrisons for meningococcic infection, clinical and laboratory studies enabled the writer to exclude it and demonstrate the tuberculous nature of the existing meningeal disorder, no healthy meningococcus carriers were ever found near the cases. The meningococcus carriers, *i.e.*, subjects that have had or have at the time a meningococcic rhinopharyngitis, must be considered the links in an unbroken chain which unites, even at a great distance, cases of sporadic cerebrospinal meningitis apparently entirely unrelated. C. Dopter (*Presse méd.*, Dec. 17, 1913).

In the recent epidemics in Georgia and Texas no case could be traced directly to another as its source of origin. The disease was confined to no one locality, though insanitary con-

ditions contributed largely. R. V. Martin (*So. Med. Jour.*, Feb., 1914).

A connection between body lice and meningitis noted in 2 epidemics. Measures to eradicate lice are indicated, with isolation until meningococci no longer occur in the blood. Pizzini (*Policlinico*, May, 1917).

PROGNOSIS.—Not many years ago 80 per cent. of the patients died and about 20 per cent. recovered. Of those that recovered, many were blind or deaf. Since the introduction of the Flexner serum, the recoveries range between 70 and 80 per cent., and the mortality between 20 and 30 per cent. One must not look for equally good results unless treatment with the serum is commenced very early. In a case of mine an infant 1 year old had been ill nine days before the serum was injected. The disease continued for seven weeks, the infant then recovering.

A perfect clinical recovery takes place in all mild cases. A complete recovery without subsequent troubles is possible even in the severer and worst cases. The probability of a recovery which will leave no trace is greater in children than in adults. In the latter sequelæ may appear two years and a half after the disease. After an apparent convalescence has lasted four weeks the onset of hydrocephalus is possible. The complication most to be feared is deafness. While all paralytic symptoms may be recovered from and a choked disc may disappear, deafness once caused is irreparable. Cohn (*Berl. klin. Woch.*, Jan. 11, 1909).

TREATMENT.—Lumbar puncture should be performed. This will relieve the excessive intracranial pressure, besides draining the ventricle of pathogenic material. Immediately after such lumbar puncture the Flexner antimeningitis serum should be

injected. If one is dealing with a young infant in which lumbar puncture has resulted in a dry tap, **aspiration of the lateral ventricles** through the open fontanelle should be performed, and the serum injected through the needle left *in situ*.

In lumbar puncture the object is to aspirate as much of the spinal fluid as possible; in some cases I have obtained 15 to 30 c.c. Through the same needle I then inject from 30 to 60 c.c. of Flexner's serum. The serum should be warmed before injection, and should be introduced slowly. It is well to elevate the hips and lower the head when injecting the serum. Daily injections of 30 to 60 c.c. are required if no improvement is noted.

The writer had a mortality of over 78 per cent. in 14 cases not treated with the **serum**, while the mortality was only 21.74 per cent. in 25 serum-treated cases, and only 11.76 per cent. in 17 cases in which the serum was injected by lumbar puncture. The disease became so modified immediately after the injection that it seemed like another type, and the complications were mild, if any appeared. No by-effects were observed from the lumbar technique, even when unusually large doses were administered. He injected 20 c.c. ($\frac{3}{4}$ fluidounce) in children and from 30 to 40 c.c. (1 to $1\frac{1}{4}$ fluidounces) in adults. Levy (Deut. med. Woch., Jan. 23, 1908).

Report of 102 cases of epidemic cerebrospinal meningitis in which **antimeningococcus serum** treatment was instituted. It was found harmless under all conditions, even for children, and had a curative effect when injected early in the disease. After the subacute or chronic stage is reached it ceases to have any influence on the disease. In severe cases it was injected into the spinal canal, after withdrawal of a little

more fluid than the amount of serum to be injected. Doses of from 5 to 10 c.c. (80 to 160 minims) can be repeated two or three times a day. Wassermann (Deut. med. Woch.; Med. Bull., Jan., 1908).

During the years 1889 to 1907 there were 33 cases of epidemic cerebrospinal meningitis treated at the Johns Hopkins Hospital; of these, 21 died and 12 recovered, a mortality of 64 per cent. In 1908 there were 19 cases, all of which received the **Flexner antimeningococcic serum**. Of these, 16 recovered and 3 died, a mortality of 16 per cent. Sladen (Johns Hopkins Hosp. Bull., vol. cciv, p. 245, 1908).

Results in 712 cases of epidemic meningitis treated with the **serum**, by different observers. Of the 712 cases, 224 died, a mortality of 31.4 per cent. The highest mortality occurred in the first two years of life and equaled 42.3 per cent. The second age period is from 2 to 5 years, in which the mortality was 26.7 per cent. The third age period embraces children from 5 to 10 years of age, and gave the lowest mortality of all, namely 15.9 per cent. The next period extends from 10 to 15 years, and gave a mortality of 27.7 per cent. The next period, of from 15 to 20 years, showed a considerable rise in mortality, equaling 32.7 per cent., and the last period, embracing the cases of 20 years and over, gave a mortality of 39.4 per cent. The writer calls attention to the importance of early injections of the serum. Of those cases in his series injected during the first three days of the disease, the mortality was 25.3 per cent. Those injected from the fourth to the seventh day showed a mortality of 27.8 per cent., while those injected later than the seventh day gave a mortality of 42.1 per cent. Flexner (Jour. Amer. Med. Assoc., vol. viii, p. 1443, 1909).

In 31 cases of cerebrospinal meningitis in children, including 8 young infants, the symptoms and course

varied widely, but **serotherapy** gave excellent results; the writer injected the serum through the same needle puncture after withdrawal of cerebrospinal fluid. **Hot baths** at 38° C. (100.4° F.), repeated three or four times a day, proved a useful adjuvant, with **ice to the head** and **sedatives**. J. Comby (*Archives de méd. des enfants*, Mar., 1910).

Untoward results in the **serum** therapy of cerebrospinal meningitis are as uncommon as in other infectious diseases. The anaphylactic symptoms that sometimes appear, such as headache, cardiac weakness, albuminuria, exanthemata, disturbances of the bladder and rectum, fever, pains in the joints, and edema, soon pass away without leaving the least permanent injury. Better results are to be obtained by the administration of a single large dose than by the use of many small doses. Schepelmann (*Wiener klin. Woch.*, Jan. 26, 1911).

Success depends on commencing treatment early, injecting the **serum** into the spinal canal, with not too small doses. The treatment is aided by **raising the foot of the bed** for 15 to 20 cm. for twelve hours after each injection. It seemed to be borne without discomfort by the patients, as a rule, but **morphine** had to be given in a few cases. The patients usually regained consciousness after the injection, the cerebrospinal fluid cleared up, and the condition grew progressively better. In 2 cases initial optic neuritis retrogressed under the serotherapy. Jochmann (*Deut. med. Woch.*, Sept. 21, 1911).

The writer had 20 cases of cerebrospinal meningitis in his charge at Athens during the recent epidemic. Under **serotherapy** all the children recovered with one exception, the mortality thus being only 7.14 per cent. A. Papapanagiotu (*Archives de méd. des enfants*, Nov., 1911).

After five years' trial the **Flexner serum** has proved its germicidal properties in the meningococcic form of the disease. It has shown this by re-

ducing a mortality that was formerly between 75 and 80 per cent. to one that is now between 25 and 30 per cent., and by the less frequent presence of complications and after-effects. Hynes (*Amer. Jour. of Obstet.*, May, 1912).

In older children the diagnosis is not so difficult as in the younger, and the prompt use of the **Flexner serum** treatment has greatly improved the prognosis in such cases. In young infants the symptoms are masked and the dread of making the lumbar puncture needlessly has deterred many from using this valuable method. Particularly difficult are the cases complicated with pneumonia, which itself is attended with cerebral symptoms. Many intestinal disorders show misleading symptoms in infants. While a day's delay is not dangerous with older children, it may be fatal for the baby. H. Koplik (*Jour. Amer. Med. Assoc.*, June 7, 1913).

The writer has used serum in 226 cases since 1907. The mortality was only 12.5 per cent. Before the use of serum, the mortality was 48.5 per cent. in sporadic cases and 83.3 per cent. in the epidemic form. The value of serum is further shown in the attenuation of the symptoms, the rarity of complications, and the rapid recovery. Netter (*Bull. de l'Acad. de Méd.*, June 29, 1915).

From the results obtained by the **intramuscular injection** of **serum** in 12 cases of cerebrospinal meningitis the writer concludes that this method is equally as efficacious as the intraspinal. It suffices to give 10 c.c. (0.66 Gm.) every 24 hours, or in grave cases every 12 hours until 30 or 40 c.c. (2 to 2.66 Gm.) have been administered. Its action is more satisfactory when given early in the disease, and when a case is seen late in its course it is preferable to do a lumbar puncture followed by an intraspinal injection to obtain a more rapid effect. Fanciulli Francesco (*Gaz. degli ospedali e delle cliniche*, Oct. 4, 1917).

The results of serum treatment in the Royal Navy showed that of the several types of serum used that prepared by Flexner was the only one very effective. In cases not treated by serum the mortality was nearly 53 per cent. as compared with 27.5 per cent. for those treated with **Flexner's serum**.

The earlier in the course of the disease the serum was begun, the better were the results.

The administration of the serum was associated with serum rashes in about 60 per cent. of the cases surviving for over 10 days. Rolleston (*Lancet*, Jan. 19, 1918).

In a series of 417 cases of epidemic cerebrospinal meningitis treated in Hong-Kong, 104 patients did not receive either serum or lumbar punctures, obtaining merely the usual Chinese treatment. Of this number 84.6 per cent. succumbed. Among 228 patients receiving Chinese treatment but also one or more lumbar punctures, the mortality was 51.1 per cent. Among 14 patients treated by lumbar puncture only the mortality was 57.1 per cent. Among 71 patients receiving 1 to 5 lumbar punctures and also a more or less incomplete serum treatment the mortality was 45 per cent. Olitzky (*Journal of Tropical Medicine and Hygiene*, Feb. 15, 1919).

Flexner's serum must be administered reasonably promptly. One must ascertain the type of coccus at the earliest possible moment, give enough serum, and resolutely adhere to the treatment. Hine (*Brit. Med. Jour.*, Sept. 18, 1920).

Before performing *intracranial* injections the scalp should be shaven and prepared with the usual aseptic precautions. The aspirating needle must be rendered sterile by boiling. It is then pushed through the anterior fontanelle downward and inward into the ventricles of the brain, at least 1 inch or more. The needle is inserted about $\frac{1}{4}$ inch to one side of the longitudinal

sinus. Kocher advocates puncturing through the frontal lobe at a point $2\frac{1}{2}$ cm. from the middle line and 3 cm. anterior to the central fissure—a point lying somewhat in front of the bregma. The needle must penetrate 4 or 5 cm. before it reaches the ventricle, and should be directed somewhat downward and backward. The ventricle in this situation is broad, extending fully 2 cm. from the middle line, and there is practically no risk of hemorrhage during the passage of the needle. With experience, and after practice on the cadaver, punctures may be safely made not only at the point of Keen and Kocher, but elsewhere if need be—through the anterior pole of the frontal lobe, through the pole of the occipital lobe, etc.; these methods, however, are more hazardous than those detailed above, and should be undertaken only by operators particularly familiar with intracranial work.

In infected cases with a beginning external meningitis there is always a certain risk of inoculating an uninfected ventricle. The same accident has occurred owing to the passage of an occluded needle through an abscess and then into the ventricle. A trocar should not be used. It is advisable to employ a needle with a rather blunt point, which will pass by vessels without cutting them. The opening in the needle should be on the side and not upon the point, lest it become plugged with brain matter.

Report of the recovery of 3 out of 4 infants, 5 to 7 months old, with severe epidemic meningitis under **serum** treatment.

The serum was injected directly into the spinal cavity to the amount of 150 to 160 c.c. in about 8 daily injections.

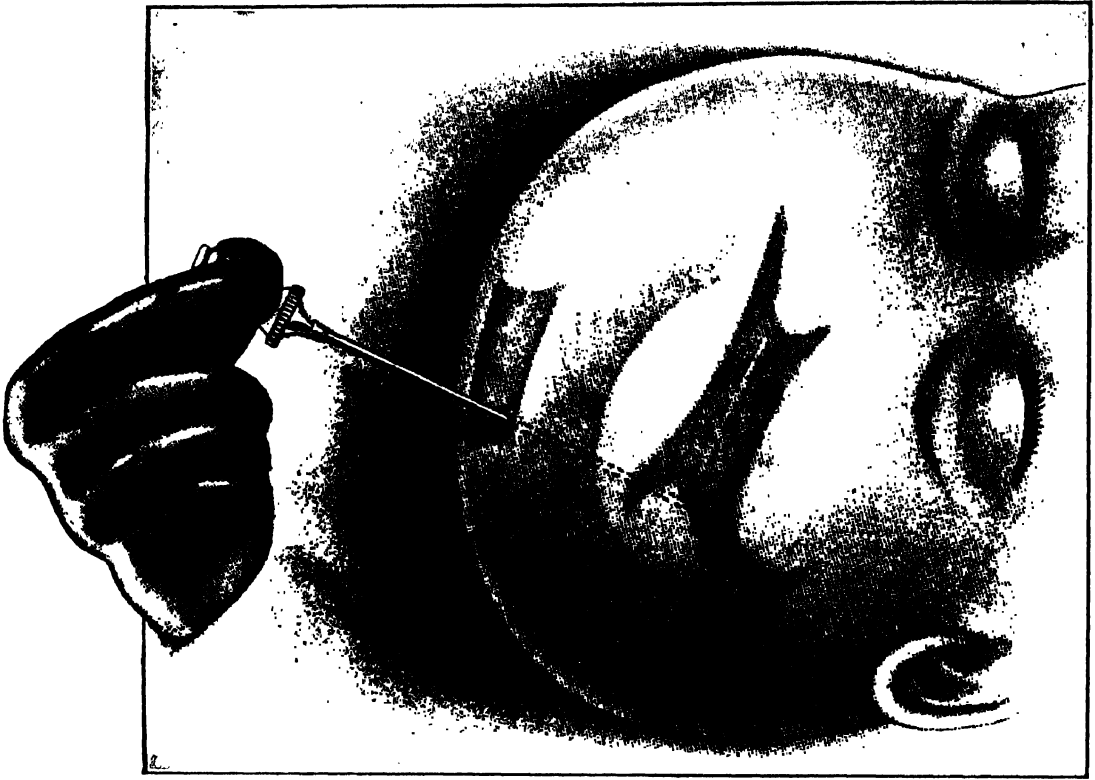
Up to 200 c.c. can be given to young infants without harm. Intolerance

does not develop usually until after several injections, with improvement far advanced.

The meningococci disappeared after 2 or 3 injections.

Where intraspinal injection is not practicable, or pyocephalus develops, the serum can be injected directly into the lateral ventricle.

was resorted to, a pint of normal saline solution being used. After as much had been drained off as possible, 50 c.c. of Flexner's serum were injected. This plan of treatment was successfully carried out in 2 of my cases. In both, lumbar puncture had yielded a dry tap.



Translucent head of child. The needle is entering the outer angle of the anterior fontanelle and penetrating the lateral ventricle, which is seen in shaded outline. The falx is dimly seen. The light line running from before backwards is the septum lucidum separating the two ventricles. (Fischer.)

An **autogenous vaccine** by the vein may usefully supplement serotherapy in the graver cases. F. de Angelis (Pediatria, Mar. 15, 1921).

In the Babies' Wards of the Sydenham Hospital, New York, there have been aspirated many times 50 c.c. of purulent fluid containing the *Diplococcus intracellularis* in almost pure culture. Using the same needle, or one having a larger caliber, irrigation

The purulent discharge gradually lessened and the meningococci gradually disappeared after serum injections continued over a period of four weeks.

A decided reaction followed each injection of serum, the child changing in color during the injection from a waxy pallor to a uniform and universal red flush. One-half hour after the injection, the child remained flushed, perspired profusely, and had

some frothy mucus at the mouth. The pulse rate was increased, the volume improved, and the tension was much higher. The leucocytes were invariably increased; the polynuclear leucocytes were the ones especially augmented, while, as a rule, the mononuclear leucocytes and the lymphocytes were reduced within six hours after the serum injection.

In the treatment of fever in cerebrospinal meningitis antipyretic measures, such as **cold packs**, an **ice-bag** on the head, and **tub baths**, are indicated. The coal-tar products, because of their depressing effect upon the heart, should be avoided. **Cupping** of the **neck** and **spine** sometimes relieves internal congestion.

Eliminative treatment is also indicated, and consists in cleansing of the gastrointestinal tract with the aid of **citrate of magnesia** or **calomel**. When high fever exists, flushing the rectum and colon with a **cold soap-suds enema** will be found useful.

As for medicinal treatment, to relieve the vomiting **cracked ice** should be given, in addition to 1-grain (0.06 Gm.) doses of **menthol**. To relieve muscular spasm, twitching, and delirium, **hyoscine hydrobromide** in doses of $\frac{1}{6000}$ to $\frac{1}{300}$ grain (0.00001 to 0.0002 Gm.) should be given, and repeated every few hours. **Morphine** hypodermically, in doses in $\frac{1}{50}$ grain (0.0012 Gm.), gradually increased, is also valuable. **Leeches** applied at the nape of the neck, over the mastoid portion of the temporal bone, or at the alæ nasi, will sometimes relieve. **Sodium bromide** in 5- to 30- grain (0.3 to 2 Gm.) doses may be given until the systemic effect is noted. **Codeine**, $\frac{1}{10}$ grain (0.006 Gm.) gradually increased until $\frac{1}{2}$ grain (0.03

Gm.) is given, will frequently soothe the nervous system. The sedative effect of a **warm bath** is also generally recognized. The bath should be given at a temperature of 100° to 105° F. in a bathtubful of water to which $\frac{1}{4}$ to $\frac{1}{2}$ pound (200 to 400 Gm.) of sulphur has been added. Such a warm **sulphur bath** may be given twice a day. The duration of each bath should be at least ten to thirty minutes.

Unless the strength is supported by food the patient will die of exhaustion. **Feeding** by mouth with **peptonized milk**, **broth**, **gruel**, and **eggs** is indicated. If, however, there is vomiting and the stomach does not retain food, **rectal feeding** should be resorted to at intervals of three or four hours.

After-treatment.—If the case progresses favorably, careful attention must be given to restorative treatment. **Codliver oil**, **Fowler's solution**, **sodium iodide**, and the **hypo-phosphites** must not be forgotten. **Electricity**, combined with **massage** and **sea-salt bathing**, is also indicated during convalescence. **Milk**, **cream**, **butter**, **eggs**, and **cereals** should form the bulk of the restorative nutriment administered. A decided **change of air**—from the city to the seashore or to the mountains—will prove beneficial.

Prophylaxis.—**Isolation** of the case is an important feature in this connection, and also, where at all possible, healthy germ carriers.

During the first three months of 1909, 139 cases of epidemic cerebrospinal meningitis developed in 45 garrisons throughout France, with 38 deaths. The patient was isolated and his two neighbors in the dormitory were also isolated for fifteen days, and

all the men in the dormitory were kept apart from the other troops and were examined for the germs. The rooms were disinfected. Among 372 men thus isolated, 72 germ carriers were discovered, but only 1 of these carriers developed the disease later. L. Vaillard (Bull. de l'Acad. de Méd., Apr. 27, 1909).

A high carrier rate usually denotes overcrowding and dangerously unhygienic conditions, even though no cases of the disease may have recently occurred. Whilst sporadic cases may occur in a military as in any other community with any carrier rate, anything approaching an epidemic of cerebrospinal fever is heralded by a warning rise of considerable height in the carrier rate. Severe overcrowding will probably be accompanied by a carrier rate (serological) of at least 20 per cent. A carrier rate of this height will usually imply that the mobilization standard of 40 square feet per man has been infringed, and that beds in the unit examined are less than 1 foot apart. It should be regarded as a signal for prompt and effective action to diminish overcrowding and to improve ventilation. The distance between beds is of paramount importance. Carrier rates from 2 to 5 per cent. may be considered usual under the best conditions obtainable in barracks and hutments. When a unit shows a high carrier rate, a distance of at least 2½ feet between the beds should be enforced. Recruits should be specially spaced out during their first three months of service. Capt. J. A. Glover (Brit. Med. Jour., Nov. 9, 1918).

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MENSTRUATION, DISORDERS OF.—Menstruation may be *defined* as a periodic discharge of sanguineous fluid from the genital tract of a woman, occurring during the period of sexual activity, from puberty to the menopause.

This definition makes no attempt to deal with the etiology of this function, which has been the subject of much speculation and many theories for many years. Probably the oldest theory of menstruation is the toxic, or chemic, which holds that certain materials which would otherwise be injurious to the organism are eliminated by this discharge. Another old theory was that the flow results from plethora. As the woman had to nourish the unborn babe, she was supposed to be endowed with superior blood-making power, and, if pregnancy did not occur, the periodic vent for superfluous blood appeared.

These various theories may be reviewed in a brief manner. The theory supported by Pflieger, Bischoff, and others holds that menstruation is dependent upon ovulation and coincident with it. On the other hand, Ruge maintains that ovulation and menstruation are two entirely independent functions. More recently, Fränkel has promulgated a new view, claiming that the act of menstruation is governed by the corpus luteum. Montgomery avers that the investigations of Fränkel justify the following theory regarding the corpus luteum and its influence on the menstrual function:—

1. The corpus luteum is a gland with an internal secretion. Following each ovulation, this gland is redeveloped in the functioning ovary and its secretion dominates the occurrence of menstruation.

2. The secretion of the corpus luteum entering the blood determines the nutrition of the uterus, especially of the endometrium, in whose connective tissue it excites extreme hyperplasia and hyperemia.

3. It prepares the uterus for the reception, retention, and nutrition of the fecundated ovum and, where fecundation has not taken place, establishes the menstrual flow.

Ruge reports his observations in a series of 106 cases in which the uterus and adnexa were removed. He finds that ovulation and the formation of the corpus luteum stand in a well-marked, close association with the cyclic changes in the uterine mucosa. The rupture of a follicle and the beginning of the development of the corpus luteum take place during the first fourteen days from the beginning of menstruation. The stage of vascularization is combined with the premenstrual changes in the uterine mucosa. The full development of the corpus luteum extends to the beginning of menstruation. The retrogressive changes in the same usually start with the beginning of menstruation and are closely connected with the interval stage to the mucous membrane of the uterus. Full development of the corpus luteum and freshly ruptured follicles were not observed in any case and one apparently excludes the other.

The mechanism of menstruation is better understood than its causation. Veit, as a result of a study of the uterus during this period, divides this phenomenon into three periods:—

1. Premenstrual congestion, in which the capillaries are distended; there is a transudation or exudation of blood into the intercellular tissues, the meshes of which are widened, and an accumulation of blood under the subepithelium, which is raised into little hillocks by the subepithelial hematmata.

2. Escape of the accumulated blood

through the interstices between the epithelial cells, which are pushed apart; some of them may be carried away by the blood as it forces its way out. There is also some desquamation of the glandular epithelium.

3. Postmenstrual involution, in which the mucosa shrinks and the extravasated blood remaining in the intercellular tissue is absorbed. The surface epithelium, raised from its subjacent tissue, sinks again to its normal level.

The menstrual blood is dark in color, alkaline in reaction, and, owing to the presence of mucus, does not coagulate unless it is excessive in amount. The discharge of mucus before and after the flow of blood is an essential part of the menstrual flux; in fact, in the lower animals the menstrual flow, if present at all, is entirely of mucus. The average duration of the flow is four or five days, but the length of the period varies in different women. When once a standard individually has been established, any marked deviation from it usually indicates some local or constitutional disorder.

It is difficult to estimate the amount of blood at each period. Authorities vary in estimating it from 2 to 8 ounces. Menstruation in the majority of women occurs every twenty-eight days, and the intervals may vary from twenty-one days to five or six weeks.

The onset of menstruation, or the time of its first occurrence, is influenced by race, climate, mode of life, heredity, and genital sense. In a series of 1000 cases studied by Krusen the average age of puberty was $14\frac{1}{2}$ years. It is seen earliest and

latest in cold climates. The peculiarities of this function vary in different families. In women of strong sexual proclivities menstruation is commonly established earlier and lasts to a greater age.

The general phenomena of menstruation are as follows: Slight elevation of pulse rate and temperature at the onset; also a tendency to slight physical depression and lassitude. The breasts and thyroid gland are often swollen and enlarged. Belfast asserts there is an increase of weight for a few days before the flow, an increment which is due to increased absorption of oxygen and to decreased elimination. There is a sense of weight, pressure, or uneasiness in the lower extremities and pelvis. General nervous excitation may be noted, and often gastrointestinal disturbance will occur. Kelly states that to define what constitutes a normal status during menstruation is difficult and that it would seem that a certain amount of pain and discomfort must be accepted as the routine condition of things for the majority of women, and the question to be answered is, therefore, At exactly what point does suffering become pathological?

VICARIOUS MENSTRUATION.

The term vicarious menstruation is inaccurate, if menstruation implies the casting off of endometrial elements, and can only be justified as a convenient one to describe the hemorrhage which appears from some other part of the body than the uterus in response to the menstrual molimen. The term is used to describe that want of co-ordination in the internal secretions, or their action, whereby the uterus does not

menstruate, but there is a flow of blood from some other part of the feminine anatomy which replaces that which should come from the genital tract.

The history of these cases is often vague and unsatisfactory. Many unusual phenomena are observed at the time of the menstrual period which may be described under this caption. Changes may occur in the mammary glands with hemorrhage from the nipple, or periodic discharge of colostrum on pressure. Local and functional changes in the eyes may be noted. The organs of nutrition may be affected and intestinal hemorrhage replace the menstrual flow. Disturbance of the skin, with acne of the face, pigmentation of the skin, herpetic eruptions, purpura, etc., may be characteristic in some individuals. These cases must not be confounded with those in which a patient may lose blood from some diseased organ, such as the lung or stomach, and the mistake be made of considering that the bleeding is the consequence of the amenorrhea instead of its cause. Sometimes the weak point is found in a nevus. Lermoyez has reported the case of a girl who had a periodic discharge of non-coagulable blood from the right ear. After the normal menstruation was established, the aural discharge rarely occurred. According to C. A. L. Reed, vicarious hemorrhage is most common from the nose; next in order of susceptibility come the stomach and intestines. Hancock has reported a case of bleeding from the left breast preceding each period.

TREATMENT.—The treatment of vicarious menstruation is to establish a flow from the uterus by the

measures recommended for amenorrhea. Seeligman advises the use of a **hot douche** during the term supposed to correspond to the intermenstrual periods. Where normal menstruation cannot occur, the unusual bleeding is a safety-valve which it is not wise to shut down. Occasionally the bleeding is so profuse from the abnormal site that radical measures are indicated, such as removal of the ovaries.

PRECOCIOUS MENSTRUATION.

This term is applied to premature menstruation. A flow of one to five days' duration must recur at regular intervals and be associated with the various feelings of discomfort analogous to those experienced by women at the catamenia, in order to be classed as precocious menstruation. Precocious maturity involving a rapid growth of the whole body in weight and height, with changes in the genital organs and mammary glands, and with the growth of hair above the genitals and in the axilla, usually precedes the menstruation. Precocious menstruation is not uncommonly associated with nymphomania. Heredity plays a prominent rôle in its occurrence, and ovarian tumors, not infrequently of a sarcomatous type, have been observed.

Strassman has collected 15 cases of menstruation beginning in the first year of life. **Bad habits** and immoral associations tend to premature development of the genital sense and **should be corrected. Masturbation should be prevented** by careful supervision of the child and by the relief of local irritations. **General rest and time treatment and removal from nervous excitement** are advised.

For AMENORRHEA, see Volume I.

For DYSMENORRHEA, see Volume IV.

MENORRHAGIA AND METRORRHAGIA.

Ménorrhagia is the term applied to abnormally profuse or abnormally prolonged menstruation. *Metrorrhagia* is irregular uterine hemorrhage at odd times without distinct periodicity. As these cannot be applied always with accuracy, it is well to employ the simple term of uterine hemorrhage to designate the abnormal flow of blood from that organ; and as precisely the same causes give rise to both classes of symptoms, they may be conveniently discussed together. Before deciding what constitutes an excessive loss of blood, it is necessary to adopt at least an approximate standard of the normal amount for the individual. Each woman is familiar with her individual norm and can easily determine deviations from it.

ETIOLOGY.—In menorrhagia the flow may be excessive throughout the usual period, or the flow may be unduly prolonged beyond the normal limits. The causes of uterine hemorrhage may belong under two classes: 1. Local or pelvic. 2. General or constitutional. It is important to emphasize the fact that all cases of abnormal or irregular bleeding from the genital tract should be the subject of careful examination to determine the cause. To neglect this investigation means increased morbidity and mortality from pelvic disease. The local causes may be uterine or extrauterine. Among those affecting the uterus itself are abortion, threatened or incomplete; mucous or fibroid polypi; submucous fibroids; carcinoma of the cervix or corpus uteri; sarcoma; chorioepi-

thelioma; acute and chronic endometritis; subinvolution of the uterus, and retrodisplacements of the uterus. Tuberculosis of the endometrium is one of the rarer causes of menorrhagia. Sclerosis or atheroma, and calcification of the uterine blood-vessels are noted in women nearing middle life or after the menopause and are factors in unusual bleeding.

An atonic uterus is not always insufficient, but insufficiency of the uterine musculature is usually a consequence of atony, although it may be due to other causes. The insufficiency becomes manifest when there is a lack of proportion between the blood-content of the uterus and the development of its muscle. In 62 cases of uterine hemorrhage under the age of 19 he found the uterus unusually small in 58; in only 4 was it of normal size. Excessive hyperemia in an insufficient musculature is liable to entail hemorrhage from it, and sexual excitement, maintaining the hyperemia in the uterus, is an important factor in uterine hemorrhage. Masturbation is extraordinarily prevalent among women, especially in the years of greatest development, but also later. The uterus accommodates itself poorly to frequent sexual excitement. Theilhaber (*Monats. f. Geburtshilfe u. Gynäk.*, June, 1910).

The extrauterine causes are extrauterine or ectopic pregnancy, in which menorrhagia is a striking symptom and early diagnosis is imperative; diseases and neoplasms affecting the ovaries and oviducts, and pelvic hematocele.

Dalché has called particular attention to syphilis as a cause of hemorrhage after the menopause, particularly that diffuse syphiloma which may form large uterine or periuterine masses simulating cancer or fibroma.

Hemorrhage from the genital organs is not always due to uterine disease. Occasionally there is noted an excessive menstrual flow just after the establishment of puberty. There is also a menorrhagic chlorosis accompanied by hemorrhage. Other conditions which produce it are lithemia, mitral stenosis, hypothyroidism, partial myxedema, and even dyspepsia. Any liver disease may be accompanied by genital hemorrhage. Arteriosclerosis in women at the climacteric may cause hemorrhage of an alarming nature, leading to the fear of malignant disease. Pouliot (*Jour. de méd. de Paris*, July 6, 1912).

Cases of very profuse and prolonged uterine hemorrhages occurring either coincidentally with the onset of puberty or shortly afterward are seen not very infrequently, and have usually been attributed to some local cause, such as uterine or ovarian congestions, inflammations, or other lesions. From a careful study of several such individuals, however, the writer has come to the conclusion that the condition is, in most instances, merely one manifestation of a general dyscrasia. In 9 cases which have come under his observation no genital lesions whatever were to be found. Most of these girls had shown a clearly marked hemophilic tendency during childhood, and in 7 there was an hereditary tendency to the same condition on the maternal side. Examination of blood taken from a vein showed in every instance increased coagulation time. The writer considers the basic trouble in all these cases to be probably some functional disturbance of all the glands of internal secretion—thyroid, pituitary, adrenals, ovaries, etc. Weil (*Ann. de méd. et chir. infantiles*, vol. xvi, p. 553, 1912).

The general or constitutional diseases causing uterine hemorrhage are anemia in exceptional cases, gout, scurvy, phthisis in the early stages, the acute infectious fevers, malaria,

influenza, saturnism, cardiac diseases causing vascular stasis, and hepatic diseases with portal stasis. In fact, any general disorder that will impede the return flow of blood from the pelvic viscera will cause an unusual vascular pressure that may result in hemorrhage from the uterus. In obscure cases the possibility of syphilis must be borne in mind and the Wassermann reaction utilized.

The practitioner should not rest satisfied until he has determined the cause of hemorrhage in his patient. If the diagnosis is not clear, it is best to employ an anesthetic and make a thorough examination of the uterus and other pelvic structures and, if necessary, dilate and curet and explore the interior of the uterus and examine suspected tissue microscopically in order to make a scientific and accurate diagnosis. It is only by such thorough investigation that carcinoma, one of the most important causes of irregular bleeding, can be detected early and the mortality from this scourge of womankind be reduced.

TREATMENT.—The first step toward effectual treatment is correct diagnosis and recognition of the cause of hemorrhage. The treatment may be general or local. By general medicinal treatment we mean the administration of such drugs as **ergot** and its derivatives, **hydrastinine**, **cotarnine hydrochloride (stypticin)**, **viburnum prunifolium**, and **adrenalin**. When some systemic disturbance, i.e., cardiac or hepatic disease, is the causative factor in the bleeding, appropriate constitutional measures must be instituted. All drugs administered by mouth should be considered as of only temporary value and as being used only to tide the pa-

tient through a period until the proper local measures are adopted for the permanent relief of the patient.

Mercury is sometimes able to conquer rebellious uterine hemorrhages even in women supposedly free from venereal disease. Several striking instances are related of complete relief from the distressing metrorrhagia under a few days of **mercurial medication**. The hemorrhage may occur in such cases without any appreciable lesion in the uterus. A. A. Mouralov (*Semaine méd.*, vol. xxvii, No. 8, 1907).

Metrorrhagia of ten or fifteen days' duration seems to be common in Argentina, in virgins or nulliparæ, with no discoverable cause for the excessive hemorrhage. Repose, a milk diet, and ergot or other styptics do not seem to influence the hemorrhagic tendency in these cases, but benefit followed injection of 10 or 20 c.c. of **antistreptococcus serum** each month, for two or three months, the menstrual flow keeping thereafter within normal bounds. E. Nuñez (*Semana Medica*, June 10, 1909).

Serotherapy was used by the writer in 10 patients with uterine hemorrhage resisting previous measures, including curetting. There were no anatomical causes for the hemorrhages, and the latter had become so severe that the general health was suffering. He injected 10 c.c. of **human serum** subcutaneously. The serum was derived from the blood of healthy patients being treated for displacement, under scopolamine-morphine just before spinal anesthesia. In every instance the hemorrhage ceased entirely or became much less severe after one or two days. Busse (*Zentralbl. f. Gynäk.*, Feb. 13, 1909).

The best results appear to have been obtained from the use of **gelatin injections**, combined with the internal administration of common salt, **sodium chloride**, in doses of 4 to 5 Gm. (1 to 1¼ drams) three times a day. This treatment yielded very

satisfactory results in a series of 29 cases under the writer's care. This common salt may also be used as a prophylactic against too severe a loss, before the onset of the regular menstrual period. Kroemer (*Folia Therapeutica; Therap. Med.*, July, 1910).

Excessive menstrual discharge in young girls, due to blood changes, is often arrested by the following:—

R. Subcarbonate of

iron gr. iss (0.1 Gm.).

Ergot (Bonjean) gr. $\frac{3}{4}$ (0.05 Gm.).

Quinine hydro-

bromide gr. $\frac{1}{8}$ (0.01 Gm.).

Extract of bella-

donna gr. $\frac{1}{12}$ (0.005 Gm.).

M. Ft. in pil. no. j.

Sig.: Two pills before meals.

Huchard and Fiessinger (*Revue de thérap.*, Mar. 15, 1910).

In several cases a single administration of 3 minims (0.2 c.c.) of **amyl nitrite** on 3 or 4 successive menstrual periods has been sufficient to effect permanent relief from the tendency to excessive losses. In others the effect has been temporary only. In these latter it has been necessary, and usually sufficient, to give during the menstrual period a regular course of **nitroglycerin**, according to the practice recently advocated by Gowers. The success of the nitrites in menorrhagia should never lead to the neglect of local conditions. But these, of course, are quite frequently not examinable. Francis Hare (*Brit. Med. Jour.*, July 15, 1911).

The first consideration is proper diagnosis, and individual treatment will depend on the conditions revealed. Where the bleeding is due to a high arterial blood-pressure, the tension must be reduced by means of **purgation, nitroglycerin, and dieting**. Purgation will also be found of value in depletion of portal circulation where hemorrhage results from hepatic cirrhosis. Should the calcium index be low, menorrhagia will be helped by the administration of this

agent, preferably in the form of **calcium lactate**. Intrauterine applications, such as **hydrogen peroxide** and **protargol**, have given good results in cases of bacterial infections. B. Whitehouse (*Lancet*, Apr. 27, 1912).

Menorrhagia and metrorrhagia are caused not by variations in ovarian secretion, but by decreased contractibility of the uterine musculature. The writer has, therefore, treated 200 patients by **injection of ergot directly into the uterine wall**. Excellent results were obtained, particularly in chronic metritis and preclimacteric hemorrhage. Naturally the treatment is contraindicated in acute inflammatory conditions and new growths of the uterus and adnexa. L. Hirsch (*Monats. f. Geburtshilfe u. Gynäk.*, Apr., 1913).

Subcutaneous injections of pituitary extract proving ineffective in obstinate cases, even when doses of 2 c.c. (32 minims) were given on several successive days, the writer resorted to **injections of pituitary extract directly into the uterine muscle** itself.

After the usual preliminary antiseptic preparation of the parts, the anterior lip of the cervix was fixed with a double tenaculum—not drawn forward, however, or but slightly—and a hypodermic needle introduced into it to a depth of 1 or 2 cm. in a direction parallel with the long axis of the uterus. The barrel of the syringe was removed for a moment, in order to make sure that no blood-vessel had been entered by the needle, then reapplied, and the injection made. The headache, cardiac acceleration, pallor, and nausea sometimes caused by ergot were avoided, and the effect on the hemorrhages was good, although less pronounced than with ergot, some slight oozing still taking place. There was noted with this drug the same possibility of a return of bleeding when the uterus relaxed as with ergot, but, on the whole, the use of the pituitary preparation is preferred. C. Koch (*Semaine méd.*, Jan. 8, 1913).

In metrorrhagia in virgins repeated **dipping of the hands in very hot, almost boiling, water** generally proves effective as a remedial measure. **Rest in bed**, with or without **heliotherapy** or exposure to **sunlight**, is indispensable. An **ice-bag** should be kept on the lower abdomen. **Calcium chloride** and **opium** may with advantage be used internally. **Vaginal injections** should be given first at room temperature then cold; they are not indispensable except to wash out clots that are beginning to undergo putrefactive changes. **Thyroid preparations** in moderate doses give good results; **mammary** or **adrenal organotherapy** also sometimes proves serviceable. **Blistering over the liver** brings about arrest of some refractory menorrhagias. Fresh **animal serum** or **antidiphtheritic serum** may be applied by the rectum, or administered internally, in a little sweetened water, before the menstrual periods. **Radium** and the **X-rays** control ovarian activity, but there is danger of overstepping the limits of safe dosing and causing permanent sterility. P. Dalché (N. Y. Med. Jour., Feb. 21, 1914).

Drugs are of little benefit, although **pituin** may be of value in young women. Dilatation and curettage finds its greatest value in diagnosis. The most satisfactory treatment, however, is by **radium** and the **X-ray**. They both have the effect of killing the follicles in the ovaries and thereby lessening the internal secretion. Radium is the more powerful in its effects; moreover, if the X-ray were continued for long, burns of the skin would result. In young girls with uterine insufficiency the writer places 50 mg. of radium in the uterus and leaves it from 4 to 12 hours. F. A. Pemberton (Boston Med. and Surg. Jour., Apr. 11, 1918).

The local measures may be subdivided into four classes: 1. Mechanical. 2. Surgical. 3. Electrical. 4. Röntgen therapy.

Very hot vaginal douches cause

uterine contractions. The **vaginal tampon or pack** of non-absorbent cotton, lamb's wool, or gauze introduced through a speculum is effective. **Intrauterine tampons** of sterile gauze may be used if the cervix is sufficiently dilated. Intrauterine applications of **iodine** in solution; **phenol** pure, diluted or combined with iodine; **creosote** in solution are useful. Kelly considers that **fuming nitric acid** is the best caustic, but it must be carefully applied through a cylindrical speculum, avoiding any excess of the acid. **Atmocausis** and **zestocausis**, introduced by Sneguireff and extensively employed in Russia, have not been popular methods in America. The cauterization of the uterine cavity by these methods is difficult to regulate, is not entirely safe, and may obliterate the cavity.

Under surgical treatment **dilatation** and **curettement of the uterus** is a procedure which often enables one to make the diagnosis and cure the patient at the same time. It is the best treatment for endometritis. It makes possible an exploration of the uterine cavity and by examination of the scrapings reliable diagnostic evidence is secured.

Routine **curetting** in all cases, regardless of pathology, without the most careful examination of the scrapings, is to be deprecated. Many cases of suspected malignant disease are found upon operation to be cases of sclerosis of the uterine vessels. Patients are usually nearing the climacteric, when we might be on the lookout for malignant disease, or their general arterial system might give evidences of early arterial changes. A. T. Jones (N. Y. Med. Jour., Nov. 30, 1912).

The writers have studied the histology, with special reference to en-

dometritis, metritis, and uterine hemorrhage, of material from 430 operative cases. They concluded that there is a hyperplasia and hypertrophy of the uterine glands, which is a pathological condition and is independent of the menstrual changes in the uterine mucosa; also that the condition is rarely caused by inflammation. Out of 175 cases in which **curetting** was done, they can report on about 111. In 38 cases there has been no severe hemorrhage since the curetting; of these 38 patients only 6 had hypertrophy or hyperplasia of the glands in the uterine mucous membrane independent of menstruation. The 61 cases with a negative result include 9 with hyperplastic or hypertrophic glands independent of menstruation. In 13 cases **vaginal hysterectomy** had to be done for recurring hemorrhages. The failure of curetting to cure in so many cases confirms the lack of connection between the hyperplasia and hypertrophy of the glands and the hemorrhages. Schickele and Keller (*Archiv f. Gynäk.*, Bd. xcv, Nu. 3, 1912).

In cases of malignant or benign neoplasms **hysterectomy** is indicated. In inflammatory or infective processes or neoplasms involving tubes and ovaries the removal of these structures will be followed by cessation of hemorrhage.

Electricity has its advocates, but it is not popular with the average gynecologist. Pfahler considers that the **Röntgen treatment** is the method of choice for the control of hemorrhage in patients approaching the menopause in whom carcinoma can be eliminated, but it is not the method in patients under 40 years of age. At the Mayo Clinic, **radium** has given the best results.

Röntgenotherapy is absolutely indicated in preclimacteric metrorrhagia, provided malignant disease of the uterus is excluded by a micro-

scopic examination of the scrapings. Women with fibromyoma who suffer from marked anemia, myocarditis, nephritis, or any other complication which renders operation dangerous should be treated with the X-ray. Great caution is required in women less than 40 years of age. Nemenoff (*Roussky Vrach*, Apr. 28, 1912).

In the Mayo Clinic **radium** is considered the treatment of choice in all cases of the menorrhagia of the menopause in which the presence of carcinoma is definitely excluded, either by history or by a diagnostic curettement, and in those cases not presenting a large, soft myoma which is apt to later undergo degeneration. It is also used in cases of profuse menstruation of the young woman (1) when there is a small submucous fibroid, (2) when no gross pathological condition is demonstrable, and (3) in cases presenting a large myoma in which there is a definite surgical risk. However, they have not entirely replaced myomectomy with radium for the treatment of myomas in the patients between the ages of 30 and 40 years. Of the 175 patients that were treated with radium from August, 1915, to December, 1917, there were 2 under 20 years of age, 34 from 21 to 30 years, 45 from 31 to 40, 91 from 41 to 50, and 14 were more than 50 years of age. Of this number 93 had had previous curettements, 37 had had more than one curettement, and 56 had undergone other pelvic operations. In 69 cases there were complications that were considered as relative, though not in every instance absolute contraindications to operation. There were heart lesions in 34 cases, hypertension in 8, kidney lesion in 11, obesity in 8, and pulmonary tuberculosis in 6. Seventy-seven of the 175 cases had definitely palpable fibroids and it is interesting to note that 155 of the 175 patients were married women, and that of these only 25 had not been pregnant. The dosage of radium is gauged by the age of the patient, and by the presence or absence of a

tumor. In the young person without a demonstrable tumor and when it is desirable to continue menstruation, usually one application of 50 mg. of radium element for from four to six hours is used. In older persons in whom it is desirable to stop menstruation entirely, it has been found that an exposure of 50 mg. for from ten to twelve hours has brought about the desired results. In cases in which large dosage is used, menstruation is usually irregular for about two months and ceases entirely after the second or third month; following the lighter exposures, it becomes regular and normal in most instances in about two months. It is the custom in the Mayo Clinic not to repeat the treatment until an interval of three months has elapsed. Stacy (Minn. Med., Mar., 1919).

For its employment special training in Röntgen technique is necessary; but in order to determine the indications for such treatment, the gynecologist should make the differential diagnosis.

Kelly's utriculoplasty for uncontrollable uterine hemorrhage consists in a wedge-shaped excision of the greater part of the uterus, the base of the triangle being situated at the tubouterine junction, while the apex lies at the internal os. This excision leaves a strip of uterine mucosa on the lateral aspects of the uterine cavity which is continuous with that of the cervix below. The two moieties of the uterus are then united, first by a series of deep mattress sutures, then by a continuous superficial suture. V. Bonney (Lancet, May 13, 1911).

Hysterotomy is the ideal operation for diagnostic purposes, for uterine hemorrhage of doubtful origin, to differentiate between pregnancy and neoplasms resembling pregnancy, placenta previa, and toxemia of pregnancy, particularly the eclamptic type. The chief contraindication is infection, demonstrated or suspected.

J. B. Deaver (N. Y. Med. Jour., June 8, 1912).

MENOPAUSE.

This critical period in a woman's existence is characterized by a cessation of menstrual activity. The average age of the climacteric is between 40 and 45 years; but the time varies as widely as does the establishment of menstruation, and its cessation frequently occurs between 45 and 50 years.

It may be premature or retarded. The average duration of the menopause, or irregularities in menstruation, is about two and one-half years.

APPROXIMATE AGE OF MENOPAUSE.

Menses begun at 10th; should cease between 50th—52d					
"	"	11th	"	"	48th—50th
"	"	12th	"	"	46th—48th
"	"	13th	"	"	44th—46th
"	"	14th	"	"	42d—44th
"	"	15th	"	"	40th—42d
"	"	16th	"	"	38th—40th
"	"	17th	"	"	36th—38th
"	"	18th	"	"	34th—36th
"	"	19th	"	"	32d—34th
"	"	20th	"	"	30th—32d

The writer worked out the above table of "Approximate Ages" as a *practical working schedule* upon which to estimate the probable date of the menopause, as the age limit beyond which no woman should be allowed to go on menstruating without a thorough examination.

These figures are intended to represent the age limit in healthy women only, and vary widely from the averages collected by E. Kriegar, which include all classes of women, regardless of general or pelvic disease.

Among 3700 patients seen by the writer in the gynecological departments of the Roosevelt Hospital, O. P. D., and the Northern Dispensary, there were 278 who had reached or passed the menopause, and, of these, 154 could recall their ages when menstruation began and ended. Of

the latter number, in 73, or 48 per cent., the menopause had been delayed beyond the "approximate age," including

3 cases of carcinoma uteri, an average of	7.0 years.
17 cases of flexion, version, or fixation, an average of	6.5 years.
15 cases of prolapsed uterus, vagina, and bladder, an average of	6.2 years.
4 cases of late recurrence, an average of	10.75 years.
39 cases, a total of 266 years, or an average of	7.00 years.

Of the same 3700 women, there were 484 over 35 years of age, 150 having passed the "approximate age" by a total of 837 years, or an average of 5.6 years, who were subject to one or another form of atypical menstruation amply justifying them in seeking relief from the burden of delayed menopause.

The menopause is "delayed" whenever menstruation is continued after the "approximate age," and this is always associated with uterine flexion, version, fixation, neoplasm, tubal disease, or syphilis, etc. A. E. Gallant (*Monthly Cyclo. and Med. Bull.*, Nov., 1910).

In a study of 800 menopause cases the writer found marked racial differences. Thus, Circassians have a later menopause than Indians; Indians later than Mongolians; dwellers in warm climates earlier than those in cold climates. Exceptions, however, were noted. The Austrian women cease menstruating 5 years earlier than the Germans, although of the same race. Persian women have a menopause 3 years earlier than Armenian women; the women of Southern Italy are later than those of the North. In the 708 cases studied the average age was from 45 to 50 years. Cases which started to menstruate either very early or very late ceased to menstruate early. This is contrary to the usual impression which supposes that very early cases continue later. Cases with extra pelvic pathology such as diabetes, nephritis, gout obesity have an average age of 47 years. Obesity often

coincides with early menopause and hypoactivity of the sex glands. Ovarian cysts induce early climacteric. Atrophic pelvic organs also induce it. The impression that early marriage produced a late menopause did not prove true; the later the marriage the later the menopause. Unmarried women have an early menopause. A number of pregnancies increase the menopause age. This is in accordance with theories of the influence of the Graafian follicle. The reproductive capacity of women is seldom used to the full extent and 34 years prove to be the average age of termination of fertility. The later the last pregnancy, the later the menopause. Profuse menstruation produces a later menopause with milder symptoms. Severe symptoms are usually attendant on an early menopause. Contrary to the usual belief a sudden menopause does not produce severe symptoms. The reverse is usually the case. K. I. Sanes (*Trans. Amer. Med. Assoc.; Med. Record*, Aug. 10, 1918).

SYMPTOMS.—During this period the patient is the subject usually of many discomforts, most of them due to vasomotor disturbances, such as flushes, sweating, cardiac palpitation, headache, melancholia, and neurasthenia. Occasionally the symptoms are more marked and the patient seeks relief for flushing of the face; a sensation of intense heat about the face and neck; palpitation of the heart; spells of weakness or prostration so great that she is compelled to frequently sit or even lie down; the flushings, etc., followed by free perspiration. With these there is more or less pronounced anemia, mental depression (sometimes almost amounting to melancholia), and broken slumber.

Some fortunate women, however, have an abrupt cessation of the men-

strual flow, and they glide away from the menstrual life easily and uneventfully. If the menopause is delayed, such prolongation of the flow may be due to pathological conditions and investigation is indicated.

During the reproductive years, the systemic blood-pressure is lowest (about 110 mm. Hg) immediately after a period, gradually rising until immediately before the next period, when it reaches from 130 to 150 mm. Hg. With the establishment of the flow, the pressure gradually subsides. This process we know to be effected by the internal secretion of the ovary, supplemented and balanced by some other internal secretions, among them probably that of the thyroid. Leonard Williams (*Clinical Jour.*, Mar. 3, 1909).

There may be a general nervous irritability, alterations in personality, moodiness, and even increased sexual desire. In the normal subject the disturbances are mild and transitory. When they are serious and persistent, resembling those produced by castrating young women, they may be looked upon as abnormal, although some women may be castrated without much disturbance of function. Jung (*Deut. med. Woch.*, Apr. 11, 1912).

The fact that malignant disease of the uterus occurs so frequently during the fourth decade of life makes vigilance necessary during the menopausal period. Any postclimacteric hemorrhage should be reviewed with suspicion and most thorough study made of the individual case.

Series of cases in women of 57 to 67 years of age who had repeated uterine hemorrhages, but refused operative treatment for the suspected cancer, and after a few months the hemorrhages ceased and there has been no further disturbance to date. The women had mostly had metritis years before, had borne numerous children, and had more or less ptosis

of the viscera. Cholelithiasis, gout, obesity, or heart, or kidney affection, or a mucous polyp—any of these is liable to induce uterine hemorrhage after the menopause. Dalché (*Gaz. degli Osped.*, Feb. 13, 1912).

When women apply late with inoperable cancers it is because they ascribed the hemorrhages observed to a natural phenomenon of the change of life. The laity should be taught insistently that the menopause is merely the gradual subsidence of menstrual hemorrhages, the losses of blood grow less and less and occur at longer intervals; any increase in frequency or amount should arouse alarm as a sign of cancer. Lehman (*Zentralbl. f. Gynäk.*, Jan. 18, 1913).

While the climacteric is well recognized in women, it is not so generally appreciated that men go through a similar readjustment of tissues, though probably at a later age. Since at this time the protective powers of the body are less active, acute illness is attended with more than average risk. The immediate counterpart in man of the ovarian changes which take place at this time in women is probably to be found in the structural alterations which become established in the prostate gland. It is not surprising that growths of malignant type so often date their inception from this period of unstable tissue life. Most interest, however, attaches to the chronic ailments met with at this period of life. Although each ailment may be considered as an entity, they are each related to the other and none is really self-contained. Arteriosclerosis, interstitial nephritis, and diabetes form a group frequently seen in men between 55 and 63. Guthrie Rankin (*Brit. Med. Jour.*, Jan. 18, 1919).

TREATMENT.—Treatment of the menopause is indicated when the symptoms pass the physiological limits. It should be hygienic, psychotherapeutic, and symptomatic. **Rest**, with regulation of diet and bowels, is indi-

cated. Bromides and other nerve sedatives should be used sparingly.

The psychic disturbances should be dealt with sympathetically, but not too seriously, and patients should be impressed with the thought that their disturbances are not unnatural and will pass over before long, leaving them probably better emotionally, mentally, and physically than they were before. It should be made quite plain that the menopause is not a time of any special danger and that the healthy woman has nothing to fear from it. At the same time any deviation from health, either local or general, must be carefully investigated and treated, without being vaguely relegated to the limbo of incidents of the change of life. A course of **ammonium bromide**, in 10-grain (0.65 Gm.) doses, three times a day, combined with some bitter tonic, such as **tincture of cinchona**, is often very useful, both in checking flushes and in allaying nervous irritability. The taking of alcohol in any form should be discouraged, as it is peculiarly apt at this time to degenerate into the insidious practice of nipping. So many women at the menopause suffer from constipation and flatulence that special treatment should be directed to these points, and the tendency to obesity should be fought against by encouraging **exercise** and discouraging afternoon naps and sitting about all day. In some cases of artificial menopause the distressing flushes can be alleviated by the administration of **ovarian extract** in 5-grain (0.3 Gm.) doses, two or three times a day, continued for several days at a time. Giles (Lancet, Feb. 12, 1910).

Purely hygienic measures will in most cases largely overcome the various "congestive" symptoms at the climacteric. Physical **exercise**, especially walking, is very valuable; while walking in the open air is to be preferred, walking in the house, in conjunction with the household duties, is by no means useless. For

the prevention of insomnia the patient should be advised never to retire until at least two hours have elapsed since supper time and to walk around as much as possible during that time. The evening meal should be light and should not include any meat. The quantity of fluid taken should be reduced to half a pint. At other meals vegetables and fruit should chiefly be taken, especially during the "congestive" periods, though well-cooked white meats are also permissible. Skimmed milk often proves more acceptable than whole milk.

As derivative measures, **hot foot baths**, **dry cupping**, rubbing of the congested region with **turpentine** or **ammonia liniment**, careful **massage**, and the use of the **faradic current** are of chief value. Internal derivation by drugs such as aloes is to be avoided except in obstinate cases. Sedation by means of **bromides**, **monobromated camphor**, or **valerian** is useful in all cases where repeated nervous attacks occur. **Asafetida** may with advantage be given in the following combination, originally recommended by Debreyne:—

R. Camphoræ,

Asafetidæãã gr. ij (0.1 Gm.).

Ext. belladonnæ

foliorum gr. ½ (0.02 Gm.).

Ft. in pil. no. j. Da tales no. lx.

Of these pills, from 2 to 6 may be administered daily; where the latter number is given, the amount of belladonna in each should preferably be reduced one-half. Of special value, especially in cases of artificially induced menopause, is the administration of dried **ovarian substance** in cachets or tablets each containing 0.1 Gm. (1½ grains); of these, 5 may be given daily. Plicque (Bull. méd., June 15, 1912).

The **extract of corpus luteum** has been of value in many cases, particularly in those of artificial menopause; but there is no special medicine that can be absolutely relied on at this period. This applies as well

to organotherapy as it does to other agents. **Ovarian extract** is recommended by some clinicians, **corpora lutea** by others; but the possible inertness of some of the preparations on the market should not be overlooked.

Corpora lutea used in 12 cases of severe nervous disturbance after bilateral oöphorectomy. The nervousness was relieved in all cases, flashes of heat in 2 cases, obstinate insomnia in 1 case. Capsules of 5 grains (0.3 Gm.) given *t. i. d.*, half to one hour before meals. C. A. Hill (Surg., Gynec. and Obstet., Dec., 1910).

In surgical menopause the writer found that while **corpus luteum extract** by mouth proved disappointing, intramuscularly good results could be obtained. Hirst (Amer. Jour. of Obstet., Apr., 1916).

In a case of premature menopause coming on after an attack of puerperal fever at 29, **pituitary extract** was begun after 10 or 12 years, and soon menstruation returned and general health improved. G. Jona (Gaz. degli Osped., Apr. 2, 1916).

There occurs in the majority of menopause cases a vacillating hypertension. The diastolic pressure is not elevated in proportion to the systolic, an increased pulse-pressure thus resulting. The hypertension is ascribed to relative oversufficiency of the hypophysis or adrenals. **Extract of corpora lutea** from animals in early gestation gradually restores the blood-pressure to normal. Carey Culbertson (Surg., Gynec. and Obstet., Dec., 1916).

The best results with **corpus luteum** were obtained in young women; they were less so in normal menopause. It proved ineffectual in surgical menopause. Klimenko (Endocrinology, Mar., 1919).

Thyroid gland is of distinct value when there are signs of hypothyroidia. **Ovarian grafting** has been tried with apparent success, but considerable

work is required to place the procedure on a solid footing.

The author describes a group of symptoms or signs frequently present at this age period which, while falling a long way short of myxedema, indicates a certain degree of deficiency of the thyroid secretion. When this subthyroidic syndrome is present he prescribes **thyroid gland extract** with much benefit, but not in the usual doses; $\frac{1}{2}$ grain (0.03 Gm.) twice a day, possibly increased, suffices. **Ichthyol** is another drug which he has learned to place reliance on in the treatment of the subjective symptoms of the menopause generally. Leonard Williams (Lancet, Apr. 30, 1910).

Ovarian extract is often useless. The tendency to obesity can be combated by restricting the number of calories in the food and by diligent out-of-door exercise. **Thyroid extract** should be tried only under constant medical supervision, and it should be abandoned at the slightest signs of injury of the heart, as it may bring on heart attacks and even sudden paralysis of the heart. Jung (Deut. med. Woch., Apr. 11, 1912).

Ovarian extract alone has not given very satisfactory results in artificial menopause, and should be reserved to combat the trophic changes—obesity, chronic rheumatism—and perhaps for certain cases of confirmed exophthalmic goiter, in which it has seemed to be of value. The congestive and nervous phenomena should be treated with agents restraining the activity of the thyroid and adrenals—for the **thyroid anti-thyroid serum**, and for the **adrenals ipecac, sodium salicylate, opium, and ergot**. In a few special cases **thyroid substance** and **epinephrin**, in small doses, were employed, on the principle that small amounts of these agents appear sometimes to reduce the corresponding function. Intelligently employed, these drugs quickly relieve the symptoms. T. Tuffier and A. Mauté (Presse méd., Nov. 23 and 27, 1912).

Case of **ovarian grafting** in a young woman who had been castrated for local causes and who had developed within two months the picture of acute ovarian insufficiency. Ordinary treatment having proved unsatisfactory, laparotomy was performed for the purpose of remedying any imperfections resulting from the operation. Scars were excised, adhesion resected, and the uterus freed from a ventrofixation. No benefit resulted. The patient's psyche now began to show impairment. The healthy ovary from a myoma castration was then transplanted into the patient's vagina. It was first fixed to the cervix and then buried beneath the vaginal mucosa. During the next few months the patient steadily improved up to complete recovery. Engel (Berl. klin. Woch., May 20, 1912).

WILMER KRUSEN

AND

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MENTAL DISEASES. See PSYCHIOSES.

MENTHA.—Two varieties of mint, *mentha piperita* and *mentha viridis*, are official.

Mentha piperita, U. S. P., or peppermint, consists of leaves and tops of *Mentha piperita*, of the family Labiatae. It has an aromatic odor and taste, and contains a volatile oil, from which menthol is obtained.

Mentha viridis, U. S. P., or spearmint, consists of the leaves and tops of *Mentha spicata*, and also contains a volatile oil. It is somewhat less powerful than peppermint.

PREPARATIONS AND DOSE.—*Aqua menthae piperita*, U. S. P. (peppermint water), contains 1:500 of the oil. Dose, 2 to 8 fluidrams (8 to 32 c.c.).

Oleum menthae piperita, U. S. P. (oil of peppermint), contains not less than 50 per cent. of total menthol. Dose, 1 to 5 minims (0.06 to 0.3 c.c.).

Spiritus menthae piperita, U. S. P. (spirit of peppermint), contains 10 per cent.

of the oil. Dose, 10 to 30 minims (0.3 to 2 c.c.).

Aqua menthae viridis, U. S. P. (spearmint water), contains 1:500 of the oil. Dose, 2 to 8 fluidrams (8 to 32 c.c.).

Oleum menthae viridis, U. S. P. (oil of spearmint). Dose, 1 to 5 minims (0.06 to 0.3 c.c.).

Spiritus menthae viridis, U. S. P. (spirit of spearmint), contains 10 per cent. of the oil. Dose, 10 to 30 minims (0.3 to 2 c.c.).

THERAPEUTICS.—The bruised fresh leaves of peppermint are useful domestic remedies for the relief of **colic**, **sick headache**, **nausea**, etc. Peppermint water is used as a flavoring agent and to lessen the griping effect of certain remedies. It is a popular remedy for **colic** and **flatulence** in infants, especially when combined with a small dose of sodium bicarbonate ("soda mint").

The spirit may be used for the same purpose in adults. The oil may be painted over the course of the nerves in **neuralgia** and **myalgia**, and over the painful joints in **arthralgia** and **chronic gout**. Evaporation should be prevented by covering with oiled muslin. In **dental caries** it acts both as antiseptic and analgesic. In **acute rheumatism** the oil may be applied to the painful joints and covered with cotton and oiled muslin. W. and S.

MENTHOL.—Menthol (mint camphor) $[C_{10}H_{19}(CH_3)(OH)(C_3H_7)]$ is a stearopten, or secondary alcohol, obtained from the essential oil of *Mentha piperita* or other peppermint oils. It occurs in colorless, acicular or prismatic, glossy crystals having a strong peppermint odor. It is soluble in alcohol, ether, carbon bisulphide, oils, and acetic acid, and is slightly soluble in water. It melts at 109.4° F. (43° C.) and volatilizes slowly at ordinary temperatures. It can be fused or compressed into cones or pencils. Chinese and Japanese oils of peppermint are richer in menthol than the official oil.

PREPARATIONS AND DOSES.—*Menthol*, U. S. P. (menthol), is the only pharmacopeial preparation. Dose, 1 to 5 grains (0.06 to 0.3 Gm.).

Menthol camphoratum, N. F. (camphor—menthol), is an oily fluid produced by

tritulating equal parts of camphor and menthol. Used externally.

Various unofficial camphor combinations, all antiseptic and analgesic, have come into use:—

Coryfin (koryfin) is the ethylglycolic acid ester of menthol; it occurs as a limpid, colorless oil, having a faint menthol odor. Dose, 3 or 4 drops on sugar.

Loeffler's solution, mentholated, consists of menthol, 10 parts; toluol, 34; liquor ferri chloridi, 4; absolute alcohol, 60.

Menthol-eucalyptol consists of menthol, 10 parts; eucalyptol, 20; oleum, ricini, 100. Dose, 30 minims (2 c.c.), by intramuscular injection.

Menthol-iodol consists of menthol, 1 part; iodol, 99. It occurs as a powder or can be molded into cones or pencils. Used externally.

Menthol-phenol consists of menthol, 3 parts; phenol, 1; melted together. Used externally.

Menthospirin is an acetylsalicylic acid ester of menthol; it occurs as a light-yellow fluid. Dose, 4 grains (0.25 Gm.) in capsule.

Validol (menthol valerate), containing 30 per cent. of free menthol, occurs as a colorless liquid of the consistency of glycerin, with a mild, pleasant odor, and soluble in alcohol, ether, chloroform, and oils. Dose, 10 to 20 drops on sugar or in sweetened wine, as nerve sedative, carminative, and stomachic.

Validol camphoratum, a 10 per cent. solution of camphor in validol. Dose, 10 to 20 drops on sugar or in wine. In odontalgia may be applied to the pulp or inserted on cotton.

PHYSIOLOGICAL ACTION.—Menthol in small doses tends, like camphor, to stimulate the heart. Toxic doses depress it, and also paralyze the central nervous system.

In the alimentary canal small doses of menthol cause slight local irritation; large doses, vomiting.

Externally, menthol depresses the nerves of pain and tactile sensation, and stimulates those of cold and heat sensations. These effects, according to the researches of Joteyko, do not set in simultaneously, but appear in the following

order: 1. Pain. 2. Cold. 3. Touch. 4. Heat. The characteristic cold sensation produced is not associated with a fall in local temperature,—the superficial vessels being in fact dilated,—but to the excitation of the nerves of cold sense. It is only when the drug is very freely used that the heat nerves are acted upon and a sensation of heat and formication results (Joteyko).

THERAPEUTICS.—Menthol may be used in doses of from 3 to 5 grains (0.2 to 0.3 Gm.) in capsules for the relief of **nervous dyspepsia** and **diarrhea**. Validol (10 drops) and menthol in doses of 1 or 2 grains (0.06 or 0.13 Gm.) are useful as sedatives in **gastralgia**, and likewise in **flatulence** in general, in the **indigestion** of **chlorosis** and of **early phthisis**, in **gastric neurasthenia**, in the **vomiting of pregnancy**, and in cases of **gastric ulcer** and even of **gastric cancer**. They are, however, contraindicated in the presence of acute inflammation of the stomach or hemorrhage.

In **hysteria** and **epilepsy** validol exerts a sedative action. Used externally, like menthol, coryfin, or menthophenol, it affords relief in painful and **neuralgic** affections, **headache**, **toothache**, **insect bites**, and **pruritus**, being rubbed or painted over the affected parts, or applied in alcoholic solution or in an ointment. One dram (4 Gm.) of menthol may be dissolved in 4 ounces (125 c.c.) of soap liniment for external use. Menthospirin and camphor-menthol may be similarly used, applied with a camel-hair pencil. The pain and itching of **herpes zoster** and **urticaria** can frequently be relieved by the application of a 5 per cent. ointment of menthol.

Menthol is given internally for the relief of **hemicrania**, **intraorbital neuralgia**, **cephalalgia**, **sciatica**, and **rheumatism** in doses of from 4 to 10 grains (0.25 to 0.65 Gm.).

Menthol, or camphor-menthol, may be used as a depletant to the mucous membranes of the nose or throat. It causes a contraction of the local blood-vessels which, unlike the action of cocaine, is not followed by increased dilatation. Dissolved in oil (1:80), or in liquid petrolatum (1:100), it may be used in a spray

for the relief of **acute coryza** and the nasal symptoms of **hay fever**. A mixture of menthol and ammonium carbonate may be used for the same purpose, inhaled from a wide-mouthed bottle or an inhal-ing tube.

Leroux, Lublinski, Mayet, and others have observed alarming dyspnea and suf-focation follow the use of menthol in the noses and throats of infants. They advise its omission from infantile therapeutics.

In **ozena**, **hypertrophic rhinitis**, **pharyn-gitis**, etc., camphor-menthol, menthol-iodol, and menthol-phenol will yield good results, used in a spray of a 1 to 4 per cent. solution in liquid petrolatum. In-halations of menthol volatilized by the addition of hot water have been used with advantage in **bronchial asthma**.

In **diphtheria** Loeffler's mentholized solution is used to remove and pre-vent the formation of false membrane. It is applied on a cotton pledget every three hours to the mucous membrane, previously dried off with cotton.

Intralaryngeal injections of 10 or 15 per cent. solutions of menthol have been used in **pulmonary tuberculosis** and in **ulcera-tions of the larynx**. Deep injections into the gluteal muscles of menthol-eucalyptol have been used with benefit in lung affec-tions marked with abundant or putrid ex-pectoration, and in pulmonary phthisis.

The menthol preparations have found favor in the treatment of painful **wounds**, especially in the case of menthol-iodol, which is odorless and non-irritating and may be used as a dusting powder or in an ointment.

Mentholized oil (10 to 15 per cent.) has been recommended in the treatment of **furuncle** of the **external auditory canal** and of diffuse swelling of the wall of that canal. In **chronic otitis media** mentho-lized oil (5 to 10 per cent.) is valuable as a mild antiseptic for the interior of the tympanum.

Equal parts of chloral and menthol form, upon trituration, an oily substance which is mildly counterirritant and anes-thetic.

Squibb's solution for local anesthesia, which is used in an ordinary hand spray, consists of menthol, 2 parts;

chloroform, 20; ether, 31. The effect lasts five minutes.

Mentholization of the air passages be-fore, during, and after etherization has been suggested by Briggs, who asserts that anesthesia is more rapidly induced, with absence of cough, suffocation, and preliminary excitement, and less post-operative nausea and vomiting. One fluidram (4 c.c.) of peppermint oil, or a 50 per cent. alcoholic solution of menthol, is poured on to the inhaler and, after 6 good inhalations, etherization is begun.

W. and S.

MERCURY.—Mercury, hydrar-gyrum, or quicksilver is a lustrous, bluish-silver-white liquid metal, which, though occasionally found in its pure state, is usually obtained from native chloride or sulphide. It is also found in amalgamation with silver. The sulphide, called native cinnabar, is mainly obtained in the mines of Al-maden, Spain, and of New Almaden, near San Jose, California. The vari-ous processes through which it is iso-lated are all based upon distillation.

Mercury is devoid of odor or taste. Its specific gravity is 13.535 times that of water. At -39.4° C. (-38.9° F.) it congeals into a malleable solid, and when exposed to a temperature of 357° C. (675° F.) boils, turning into a colorless vapor. It volatilizes spontaneously to a less extent, how-ever, at all ordinary temperatures. It is soluble in nitric acid and in boiling sulphuric acid.

PREPARATIONS AND DOSE.—The official preparations of mer-cury may appropriately be classified in several distinct groups, as follows:

A. Metallic Mercury.

Hydrargyrum, U. S. P. (mercury) [Hg], is not less than 99.9 per cent. pure.

Hydrargyrum cum creta, U. S. P. (mercury with chalk; gray powder),

made from 38 parts of mercury, 10 parts of clarified honey, 57 parts of prepared chalk, and a small amount of water. The finished product contains 38 per cent. of mercury, and occurs as a light-gray, smooth powder with a slightly sweetish taste. Dose, in adults, 4 grains (0.25 Gm.); in children, $\frac{1}{2}$ to 2 grains (0.03 to 0.12 Gm.).

Massa hydrargyri, U. S. P. (mass of mercury; blue mass), made from 33 parts each of mercury and honey of rose, 10 parts of licorice, 15 parts of althea, and 9 parts of glycerin. Trituration is continued until the mercury (33 per cent.) globules are no longer visible under a microscope magnifying 10 diameters. Dose, 1 to 10 grains (0.06 to 0.6 Gm.); official average dose, 4 grains (0.25 Gm.).

Unguentum hydrargyri, U. S. P. (mercurial ointment), made from 50 parts of mercury, 2 parts of oleate of mercury, 23 parts of prepared suet, and 25 parts of benzoinated lard. Trituration is continued to the same point as for blue mass. Used externally.

Unguentum hydrargyri dilutum, U. S. P. (blue ointment), made by mixing 67 parts of mercurial ointment with 33 parts of petrolatum, and therefore containing 33 per cent. of mercury. Used externally.

Emplastrum hydrargyri, U. S. P. VIII (mercurial plaster), made by trituration of 30 parts of mercury with 1 part of oleate of mercury, 10 parts of hydrous wool-fat, and 59 parts of lead plaster. Used externally.

B. Oxides of Mercury.

Hydrargyri oxidum flavum, U. S. P. (yellow mercuric oxide; yellow precipitate) [HgO], made by precipitation of 10 parts of corrosive mercuric

chloride, dissolved in 100 parts of distilled water, with 4 parts of sodium hydroxide, dissolved in 100 parts of distilled water. It occurs as an orange-yellow, heavy, impalpable powder, with a somewhat metallic taste, darkening on exposure to light, almost insoluble in water, insoluble in alcohol, but soluble in diluted hydrochloric or nitric acid, forming colorless solutions. Used externally.

Hydrargyri oxidum rubrum, U. S. P. (red mercuric oxide; red precipitate) [HgO], occurring in heavy, orange-red scales or powder, with a somewhat metallic taste, with the same solubilities as the preceding. Used externally.

Oleatum hydrargyri, U. S. P. (oleate of mercury; mercuric oleate), made by triturating 25 parts of yellow mercuric oxide in 25 parts of water, adding 70 parts of oleic acid, mixing thoroughly, and warming to evaporate the water; enough oleic acid is then added to make 100 parts. It contains 25 per cent. yellow mercuric oxide, is of firm butter consistence, and of a yellow color. The 5, 10, and 20 per cent. oleates of mercury can be prepared from the official (U. S. P.) by diluting the same with oleic acid.

Unguentum hydrargyri oxidi flavi, U. S. P. (ointment of yellow mercuric oxide), made by trituration of 10 parts of the yellow oxide with 10 parts of water and 40 parts each of hydrous wool-fat and petrolatum. Used externally.

Unguentum hydrargyri oxidi rubri, N. F. (ointment of red mercuric oxide), made in a manner similar to the preceding, and likewise containing 10 per cent. of the mercury oxide. Used externally.

C. Ammoniated Mercury.

Hydrargyrum ammoniatum, U. S. P. (ammoniated mercury; white precipitate) [HgNH_2Cl], made by pouring a 5 per cent. solution of corrosive mercuric chloride into ammonia water, and collecting, washing, and drying the precipitate. It should contain not less than 78 per cent. nor more than 80 per cent. of metallic mercury and occurs in white pieces or powder, with an earthy and afterward styptic and metallic taste, insoluble in water or alcohol, but readily soluble in warm mineral acids and in a cold solution of ammonium carbonate. It is decomposed on prolonged washing with water. Used externally.

Unguentum hydrargyri ammoniati, U. S. P. (ointment of ammoniated mercury), made from 10 parts of ammoniated mercury, 50 parts of white petrolatum, and 40 parts of hydrous wool-fat. Used externally.

D. Nitrates of Mercury.

Liquor hydrargyri nitratis, N. F. (solution of mercuric nitrate), made from 40 parts of red mercuric oxide, 45 parts of nitric acid, and 15 parts of distilled water. It contains about 60 per cent. of mercuric nitrate [$\text{Hg}(\text{NO}_3)_2$] and 11 per cent. of free nitric acid, and occurs as a clear, nearly colorless, heavy liquid, with a faint odor of nitric acid. Used externally.

Unguentum hydrargyri nitratis, U. S. P. (ointment of mercuric nitrate; citrine ointment), made by heating 760 parts of lard to 105°C ., and gradually adding 175 parts of nitric acid in a portion of which 70 parts of mercury have been dissolved. It is not a stable preparation, and should be freshly prepared. Used externally.

E. Iodides of Mercury.

Hydrargyri iodidum flavum, U. S. P. (yellow mercurous iodide; green iodide of mercury; mercury protiodide or protoiodide) [HgI], made by preparing a solution of mercurous nitrate with nitric acid and mercury, precipitating it with a solution of potassium iodide, and washing and drying the precipitate. It occurs as a bright-yellow, amorphous, tasteless powder, darkening on exposure to light through decomposition into mercury and mercuric iodide. It is almost insoluble in water, and wholly insoluble in alcohol or ether. Dose, $\frac{1}{8}$ to $\frac{1}{2}$ grain (0.008 to 0.03 Gm.); official average dose, $\frac{1}{5}$ grain (0.012 Gm.).

Hydrargyri iodidum rubrum, U. S. P. (red mercuric iodide; mercury biniodide) [HgI_2], made by pouring solutions of corrosive mercuric chloride and potassium iodide simultaneously into distilled water, and collecting, washing, and drying the precipitate. It occurs as a scarlet-red, amorphous, tasteless powder, almost insoluble in water, soluble in 116 parts of alcohol and in 85 parts of ether; it is also soluble in solutions of the iodides, mercuric chloride, sodium thiosulphate, and hot solutions of the alkali chlorides. Dose, $\frac{1}{32}$ to $\frac{1}{8}$ grain (0.002 to 0.008 Gm.); official average dose, $\frac{1}{20}$ grain (0.003 Gm.).

Liquor arseni et hydrargyri iodidi, U. S. P. (solution of arsenous and mercuric iodides; Donovan's solution). For composition, see ARSENIC. Dose, $1\frac{1}{2}$ minims (0.1 c.c.).

Liquor hydrargyri et potassii iodidi, N. F. (solution of mercuric and potassium iodides; Channing's solution), contains 1 per cent. of red mercuric iodide and 0.8 per cent. of potassium iodide. Dose, 3 minims (0.2 c.c.).

F. Chlorides of Mercury.

Hydrargyri chloridum corrosivum, U. S. P. (corrosive mercuric chloride; mercuric chloride; bichloride of mercury; corrosive sublimate) [HgCl_2], occurring in heavy crystals or crystalline masses, with an acrid and persistent metallic taste, soluble in 13 parts of water, in 3 parts of alcohol, and in 14 parts of glycerin. Dose, $\frac{1}{100}$ to $\frac{1}{3}$ grain (0.0006 to 0.02 Gm.); official average dose, $\frac{1}{20}$ grain (0.003 Gm.).

Hydrargyri chloridum mite, U. S. P. (mild mercurous chloride; mercurous chloride; calomel) [HgCl], occurring as a white, impalpable powder, becoming yellowish on trituration under strong pressure, tasteless, and insoluble in water, alcohol, ether, or cold dilute acids. Dose, $\frac{1}{4}$ to 10 grains (0.015 to 0.6 Gm.); official laxative dose, 2 grains (0.125 Gm.), and alterative dose, 1 grain (0.065 Gm.).

Pilule cathartice compositae, U. S. P. (compound cathartic pills), each containing $1\frac{1}{3}$ grains (0.08 Gm.) of compound extract of colocynth, 1 grain (0.065 Gm.) of calomel, $\frac{1}{3}$ grain (0.02 Gm.) of resin of jalap, and $\frac{1}{4}$ grain (0.015 Gm.) of gamboge. Dose, 2 pills.

G. Salicylate of Mercury.

Hydrargyri salicylas, U. S. P. (basic mercuric salicylate) [$\text{C}_6\text{H}_4\text{COO.Hg}$], occurring as a white powder, containing 54 to 59.5 per cent. of mercury. It is nearly insoluble in water or alcohol, but dissolves in a warm solution of sodium chloride and in dilute alkalis. Dose, $\frac{1}{50}$ to $\frac{1}{3}$ grain (0.0012 to 0.02 Gm.). Official average dose, $\frac{1}{15}$ grain (0.004 Gm.).

Pulvis hydrargyri chloridi mitis et jalapæ, N. F. (powder of mild mercurous chloride and jalap), a mix-

ture of 1 part of calomel with 2 of jalap. Dose, 10 grains (0.6 Gm.).

Lotio flava, N. F. (yellow wash), made by dissolving 3 parts of mercuric chloride in 40 parts of boiling water and adding lime-water to make 1000 parts. Used externally.

Lotio nigra, N. F. (black wash), made by dissolving 8.8 parts of mild mercurous chloride in 40 parts of water and adding enough lime-water to make 1000 parts. Used externally.

In addition to the above preparations, the following unofficial combinations of mercury are in use:—

Mercuric benzoate [$\text{Hg}(\text{C}_7\text{H}_5\text{O}_2)_2 + \text{H}_2\text{O}$], occurring in white crystals, insoluble in water, slightly soluble in alcohol, and easily soluble in solutions of sodium chloride or ammonium benzoate. Dose, $\frac{1}{32}$ to $\frac{1}{5}$ grain (0.002 to 0.012 Gm.); may be given hypodermically.

Mercuric cyanide [$\text{Hg}(\text{CN})_2$], occurring in colorless prisms with a bitter taste, darkened by light, and soluble in water and alcohol. Less irritating than mercuric chloride. Dose, $\frac{1}{32}$ to $\frac{1}{5}$ grain (0.002 to 0.012 Gm.). Also used externally in 0.01 per cent. solution.

Mercuric oxycyanide [$\text{HgO.Hg}(\text{CN})_2$], occurring as a white, crystalline powder, soluble in hot water. Used externally as antiseptic in 0.2 to 2 per cent. solution.

Mercury subsulphate (basic mercuric sulphate; turpeth mineral) [$\text{HgSO}_4.2\text{HgO}$], occurring as a heavy, lemon-yellow powder, almost tasteless, partially soluble in water, and soluble in acids. Dose, as alterative, $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015 to 0.03 Gm.); as emetic, $1\frac{1}{2}$ to 3 gr. (0.1 to 0.2 Gm.).

Mercuric succinimide (or imido-succinate) [$\text{Hg}(\text{C}_2\text{H}_4\text{C}_2\text{O}_2\text{N})_2$], oc-

curing as a white, crystalline powder, soluble in 50 to 75 parts of cold water, and in 25 parts of water with the aid of heat. Dose (hypodermically), $\frac{1}{8}$ to $\frac{1}{3}$ grain (0.012 to 0.2 Gm.).

INCOMPATIBILITIES. — Mercuric chloride is incompatible with alkaloids, alkalies, lime-water, and soap. A small quantity of green soap is sufficient to destroy a large basinful of bichloride solution. Carbonates, silicates, and sulphates, such as occur in natural waters, also decompose mercuric chloride (Bastedo).

MODES OF ADMINISTRATION.—The several methods of administration of mercury, particularly in syphilis, may be enumerated as follows: (1) oral; (2) intramuscular; (3) inunction; (4) intravenously; (5) by the respiratory tract—(a) mask, (b) chest protector, (c) plaster; (6) suppositories; (7) fumigation; (8) baths (Freshwater). By mouth the preparations generally used are the protiodide, the biniodide, the bichloride in admixture with potassium iodide (forming the biniodide), and in children mercury with chalk. The disadvantage of oral administration is the special tendency to gastroenteric disturbance upon prolonged treatment.

Addition of glycerin will keep mercurial pills from drying up. The author combines opium and guaiac with the mercury and glycerin, to increase the tolerance of the intestines for the mercury, using $\frac{1}{8}$ grain (0.01 Gm.) of bichloride of mercury, $\frac{1}{8}$ grain (0.02 Gm.) of extract of opium, and $\frac{3}{8}$ grain (0.04 Gm.) of extract of guaiac, with glycerin enough to make 1 pill. Two or three of these pills are ordered daily, before or during meals; if the patient tolerates the mercury the dose may be increased to 6 a day, if required. Martinet (Presse méd., Nov. 9, 1907).

For the routine treatment of syphilis intramuscular injection is by many considered best, being most convenient, cleanly, and exact. Injections of mercury bichloride are, however, decidedly painful and irritating to the tissues, though the pain may be diminished by addition of sodium chloride or some local anesthetic to the solution. Mercuric salicylate acts less harshly on the tissues than the chloride, not being followed usually by scarring or abscesses (Montgomery). It is generally given in liquid paraffin in 10 to 20 per cent. strength, and in doses of $\frac{1}{2}$ to $1\frac{1}{2}$ grains (0.03 to 0.1 Gm.), injected into the buttock once a week or oftener. The more soluble mercuric benzoate is also a good preparation, though it is more rapidly absorbed and must therefore be given at shorter intervals, *e.g.*, on alternate days. Other relatively non-irritant preparations of mercury suitable for intramuscular injection are the albuminate (kept in solution by means of sodium chloride or carbonate), the cyanide, and the thymolacetate. Injections of insoluble preparations suspended in oil, *e.g.*, calomel, yellow oxide, or metallic mercury (as a 50 per cent. suspension in hydrated wool-fat), are also in use, though with such preparations there is some danger of temporary non-absorption, with later possibly sudden absorption of a large quantity, resulting in marked mercurial intoxication. Proper depth of injection—always well through the fatty tissues—is an important point in the avoidance of local irritative or necrotic effects.

Mercury salicylate may be rendered sufficiently soluble to afford a satisfactory hypodermic solution as

follows: Heat 1 Gm. (15 grains) of mercury salicylate with 2 Gm. (30 grains) of sodium chloride and 35 c.c. of water on a water-bath, stirring until dissolved. Then add *hot* water to make 250 c.c. ($\frac{1}{2}$ pint). This solution will remain clear on cooling; it may be filtered if necessary. Five c.c. (80 minims) of this solution represents 0.02 Gm. ($\frac{1}{3}$ grain) or the average dose of the salt. Mercury salicylate is often prescribed in oily mixtures, but, as it is not soluble in oils, it is merely suspended in them. (Merck's Archives, April, 1911.)

Equal parts of quinine and urea hydrochloride, 2 per cent., and mercuric chloride, 2 per cent., both dissolved in distilled water, when heated to the boiling point and mixed, form a clear solution. The solution should be injected warm. Stronger solutions have a tendency to cause local induration. C. M. Watson (Jour. Amer. Med. Assoc., June 3, 1911).

Red mercuric iodide with an equal amount of potassium iodide can be given intravenously. It is very little if any more toxic than mercuric chloride, safer for intravenous use, and a stronger germicide. Rowe (Jour. Lab. and Clin. Med., Apr., 1918).

The inunction method, though in general highly efficient, is less precise than the intramuscular use of soluble mercurials, and, besides soiling the clothing, is apt to irritate the skin. The procedure consists in rubbing thoroughly 10 to 30 grains (0.6 to 2 Gm.) of mercurial ointment, frequently diluted one-half, into the inner surface of the thighs, on the chest, the back, and the abdomen, daily or on alternate days. The oleate of mercury (unofficial), or the ointment of ammoniated mercury (more irritating), is also at times employed. Previous free diaphoresis hastens the absorption of the mercury. According to Juliusberg, mercury administered by inunction ac-

ually enters the system, chiefly through the respiratory tract.

The intravenous method, as now usually carried out, consists in the daily introduction, under rigid asepsis, into a vein of the arm of a 1 per cent. solution of cyanide of mercury to the amount of 20 minims (1.25 c.c.). The method is painless, and is advised in **persistent headaches** in the **secondary stage of syphilis**, for **specific eye affections**, and in general where other methods fail. Its utility has been diminished as a result of the introduction of salvarsan.

Introduction of mercury by the respiratory route is sometimes effected by the use of a mask, made of flexible wire covered with two layers of gauze, impregnated with 2 drams (8 Gm.) of metallic mercury. The mask is worn for six weeks during sleep, and is renewed every ten days. Blaschko causes mercury to be inhaled through the wearing of the so-called "mercolint bib," fitting over the chest and back and consisting of cotton impregnated with a 90 per cent. mercurial ointment. The bib is worn continually until it begins to turn white, when a new one is obtained. Treatment by mercurial plasters, including the French "emplâtre de Vigo," is unsatisfactory, except for the local treatment of certain syphilides (Freshwater).

Description of an improved technique for mercurial treatment by direct inhalation, in which air is heated by an alcohol lamp, and, passing over amorphous mercury, is conveyed to the nose by a tube and small cap fitting over the nose alone and held in place with a head-band. The amount of mercury to be inhaled can be exactly measured; the patient can read and be comfortable while taking his hour courses of in-

halation. None of the fumes get into the mouth and there is no danger of stomatitis. The patients rapidly acquire the ruddy aspect of health and gain in weight, while the influence on the manifestations of the syphilis appears more radical than with any other treatment. The fumes pass directly into the arteries by this method. This is of paramount importance, as syphilis seems to attack the vascular system pre-eminently. Engelbreth (Ugeskrift for Laeger, May 30, 1912).

Suppositories of mercury may be formulated thus: Gray oil (French), 40 per cent., 0.075 c.c. ($1\frac{1}{4}$ minims); cacao butter, 4 Gm. (1 dram). A suppository may be used nightly for a month, an intermission of a week being then made, before another month of treatment is begun.

New method of administering mercury by utilization of the preputial sac. Marked success was obtained by this method. The author employs 1 dram (4 Gm.) of mercurial ointment mixed with sufficient cacao butter to make a small pastille, or the mixture may be molded into elongated rolls. The foreskin is retracted, the pastille or roll placed in the coronary sulcus, and the foreskin brought forward again. In four hours the drug has been completely absorbed. The method was tried in 40 patients without the slightest local irritation in any. Milian (Jour. de méd. et de chir., Jan. 25, 1910).

In nervous lesions followed on late syphilis, *e.g.*, tabes, the inunction treatment is as a rule more satisfactory than the intramuscular, the results being sometimes marvelous. Treatment by the mouth should be carried out only when it is not possible to give injections or inunctions; it is certainly often useful to give mercury by the mouth between the routine courses of injection. The intravenous method is better let alone except in very severe cases in which other means have failed, and in acute

lesions of the ophthalmic apparatus in which there is danger of loss of sight. The "mask" is the most satisfactory method of introducing mercury by respiration; it is very suitable as an alternative method to oral administration. The "mercurial bib" is very suitable for children. Suppositories offer a good alternative method and may be used off and on for a long time; they are *par excellence* the simplest method of giving mercury secretly when it is necessary. Freshwater (Lancet, Aug. 10, 1912).

Mercurial fumigation is practised by having the patient sit on a chair, covered from the shoulders down to the floor with a blanket, and volatilizing 20 grains (1.25 Gm.) of calomel under the chair by means of an alcohol lamp. This method is no longer much used, except locally for the treatment of superficial lesions. Baths can be given with a solution of 1 dram (4 Gm.) each of mercury bichloride and diluted hydrochloric acid in 30 gallons (120 liters) of water, or with a solution of 1 dram (4 Gm.) of mercury biniodide and 2 drams (8 Gm.) of sodium chloride, in the same amount of water (Freshwater). The results are not sufficiently satisfactory to render this method a valuable one.

Local fumigation by means of a calomel fumigator cannot be too highly praised. The results obtained in **chronic ulceration**, **mucous plaques**, and specific **onychia** are at times quite remarkable. The fumigator consists of a glass tube about 10 inches long, pointed at one end and provided with bellows at the other. In the middle the glass is blown out into a bulb. A small alcohol lamp hangs on the glass tube so that the flame can play just under the bulb. In the bulb is placed 10 grains (0.6 Gm.) of calomel, which, vaporized, is blown on to the affected part. D. Freshwater (Lancet, Aug. 10, 1912).

CONTRAINDICATIONS. — The use of mercury is by some considered contraindicated in nephritis, except if of syphilitic nature; likewise, after the sixth month of pregnancy. Where the resistance of the body is lowered by chronic disease or cachexia, it is also generally considered contraindicated, as chronic poisoning is then readily induced. Busch advises against its use in the presence of Addison's disease. S. K. Smith has called attention to the danger of administering mercurials to feeble old persons with septic mouths; in such cases dangerous salivation may ensue from even single doses of calomel or blue pill.

PHYSIOLOGICAL ACTION.—**Externally**, mercury produces effects which depend upon its property of combining with proteins to form an albuminate. The life of the tissues or cells thus acted on is necessarily destroyed; hence the antiseptic value of mercurial compounds. The albuminate of mercury is peculiar in being soluble in an excess of protein, and this favors deep penetration and a well-marked corrosive action on the part of the mercurial compounds. An especial affinity of the mercury ion for the amino compounds comprised in the protein molecule has been held to account for its relatively high corrosive power.

The power of mercury as an antiseptic in certain instances is illustrated by the fact that corrosive sublimate will retard the growth of some bacteria and kill protozoa in a 1:1,000,000 solution and will inhibit the anthrax bacillus in blood containing 1 part in 8000 of it. Yet it has become evident that too general a reliance has been placed on the germicidal

value of this compound: According to Geppert, anthrax spores can be placed in a 1 per cent. solution of corrosive sublimate for hours and yet develop when the mercurial has been washed away. This is because the action of the salt is a superficial one; it lacks penetrating power.

Brought into contact with the skin, corrosive sublimate in crystals or strong solution is capable of causing a deep caustic action followed by sloughing. Weak solutions, if long enough in contact, cause roughening and discoloration, or even a dermatitis. Insoluble mercurials may also induce local irritation if rubbed into the skin. Mucous membranes are easily corroded by mercury bichloride, and when it is injected subcutaneously or intramuscularly severe pain is produced. Insoluble mercurials, because of slower absorption, are more likely to lead to abscess formation, followed by scarring, than is corrosive sublimate itself.

General Effects.—*Nervous System.*—In acute mercurial poisoning no symptoms of direct nervous involvement are, as a rule, manifest, but in chronic poisoning tremor, hallucinations, muscular weakness, and partial anesthesia betoken some degree of nervous interference.

Circulation.—The heart muscle and vascular tone are depressed only by toxic doses of mercurials. Injected subcutaneously, large amounts of corrosive sublimate cause a gradual, and when injected intravenously a more sudden, fall in blood-pressure. The changes in the pulse in the average case of acute mercurial poisoning are ascribed by Cushty rather to shock and collapse than to a direct effect of the drug on the heart.

Alimentary Tract.—Mercurials appear to exert a rather special action on the salivary and oral mucous glands, causing, when pushed, profuse discharge of a mercury-laden, irritating saliva with a metallic taste, and a stomatitis which may eventuate in the formation of ulcers.

Alterations produced in the parotid glands by mercury or its salts are essentially degenerative, and vary, according to the method of administration and duration of action of the poison, from mere tumefaction of the glandular epithelium to its death and disintegration. Deposition of mercury in the glands is constant only when the organism is saturated with the poison and when the principal eliminating organs are no longer able to deal with the amount of it present. E. Giani (*Lo Sperimentale*, vol. lxvi, No. v, 1913).

The stomach and small intestine, with the contained digestive ferments, are relatively little influenced by mercury. The cecum and colon, on the other hand, appear to be very susceptible to its action and respond quickly to ingestion of an excess of the element by hyperemia and swelling of the mucous membrane, followed by necrotic changes, ulcer formation, dysenteric symptoms, and, possibly, perforation.

Mercurials ingested in small amounts induce purgation, presumably by direct irritation of the intestinal walls. The insoluble preparations are thus employed, as irritation of the stomach is thereby avoided, and the local effects are not developed until the drug reaches the intestinal epithelia, for which it has special affinity, partial dissolution of the mercurial preparation being then probably effected. The green stools not infrequently associated with calomel pur-

gation are believed to arise not through an action of the drug in increasing the flow of bile,—which effect has been shown not to occur,—but through its antiputrefactive action, the bile being, therefore, preserved from bacterial decomposition, as well as hastened in its passage through the alimentary tract.

Two rabbits were enclosed in a partitioned box, rabbit A breathing only the fresh outside air, rabbit B only some mercury laden air within the box. A large depilated area on the back of rabbit A. was rubbed with a mercurial ointment. The experiment, repeated five times, proved that absorption of mercurials applied by inunction is through the skin rather than through the lungs. An ointment of calomel was shown to be more rapidly absorbed than the common blue ointment and had the advantage of not being dirty and staining the clothing. The formula used was:

Hydrargyri chloridi

<i>mitis</i>	45 gr. (3 Gm.).
<i>Lanolini</i>	15 gr. (1 Gm.).
<i>Adipis benzoinati</i>	30 gr. (2 Gm.).

For each inunction. Schamberg, Kolmer, Raiziss and Gavron (*Jour. Amer. Med. Assoc.*, Jan. 19, 1918).

Kidneys.—Diuresis is a frequent effect of moderate doses of calomel, especially in cases of cardiac dropsy. The extent of diuresis tends to vary inversely with that of purgation. Wellander has shown that the elimination of mercury through the kidneys is attended by more or less temporary irritation when the drug is administered for some time, and Fürbringer asserts that syphilitics under mercurial treatment frequently develop nephritis, from which, however, recovery tends always to occur upon cessation of the drug. At least, albumin and casts are often found in the urine of mercury-treated

syphilitic patients. According to some, these findings are less frequent in those given injections of soluble mercurials than in those given insoluble salts subcutaneously or treated by inunction.

The evident renal irritant property of mercurials would tend to suggest that the diuretic action of calomel is due to direct irritation of the kidney cells. Some believe its effect, however, due rather to the relief of splanchnic—including renal—congestion through the removal of fluid by the bowels consequent on purging.

In toxic amounts mercurials lead to changes in the renal tissues, anuria frequently resulting. These changes consist in necrosis of the epithelium of the convoluted tubules, accompanied by diffuse congestion of the organ and, if the process be long enough continued, by degeneration of the glomeruli and fibrosis. A peculiar feature is the not infrequent deposition of calcium phosphate in the injured convoluted tubules.

Blood.—Wilbouchewitch showed that large doses of mercury caused a reduction in the number of red blood-corpuscles, while small doses prevented their destruction. When, however, small doses were administered during too prolonged a period, anemia was again observed. Keyes, in a series of experiments, further demonstrated that small doses of mercury not only arrest the destruction of corpuscles due to syphilis, but actually cause an increase, which steadily progresses until the normal is attained.

Large doses, on the contrary, exert an opposite influence, being distinctly debilitating. Robin, acting on these conclusions, found that in syphilitic or non-syphilitic

subjects, and in whatever way administered, mercury always caused an increase of blood-corpuscles, provided an intercurrent gastric disorder were not present or the untoward effects of the drug—salivation, etc.—were not produced. The onset of these disorders marked the beginning of an hypoglobulia, or decrease in the number of corpuscles. Kupferwasser found that in the blood of healthy subjects the proportion of young leucocytes is considerably increased and that of old leucocytes considerably diminished by mercury. The blood of syphilitics, on the other hand, reacts to mercury by a considerable diminution in the proportion of young and a corresponding increase in that of old leucocytes. This reaction is independent of the stage of the disease, and takes place whether there are at the time syphilitic manifestations or not, and also whether the patient has or has not previously been subjected to treatment by mercury and iodides. Those who have undergone treatment by mercury within four months before the blood examination form the only exception to this rule. In such cases the reaction of syphilitic is replaced by that of healthy blood, possibly because the patient still retains a considerable quantity of mercury, or because under its influence the disease has become so attenuated that the blood gives a normal reaction.

Older observers had noted a diminution of fibrin, and as a result an abnormal fluidity of the blood that predisposed to hemorrhage. Lowering of the rate and tension of the pulse and of the temperature, sometimes to the extent of nearly 2° were also noted,—all evidence that the rem-

edy had been administered in injudicious doses in these cases.

The observations of Krohl tend to show that mercury in small doses has, to some extent, the property of conferring immunity against septic processes.

Small quantities of mercury accelerate and accentuate immune serum hemolysis *in vitro*, so that possible fixation of complement may be missed. Corrosive sublimate, injected subcutaneously, will likewise appear in the blood of the living rabbit in sufficient strength to inhibit complement fixation. Thus, caution must be exercised in interpreting the disappearance of a previously positive Wassermann reaction in a patient under mercurial treatment. This disappearance may be due simply to the fact that enough mercury is circulating in the patient's blood to inhibit the reaction. Epstein and Pribram: (Zeit. f. exper. Path. u. Therap., Bd. vii, S. 549, 1909).

The author observed that patients taking a course of mercurial treatment seemed to be peculiarly resistant to ordinary infectious diseases, especially to epidemics of cholera. This fact and others suggested that mercury might have an action on the blood, rendering it immune to septic processes, and the author's experiments with 77 rabbits apparently confirm this. Rabbits injected with mercuric benzoate bore without harm the injection of serum from the blood of a woman who had died of puerperal fever, or injection of pure cultures of streptococci. The doses of mercury given were small; a series of injections of 0.0015 Gm. ($\frac{1}{2}$ grain) to 1 kg. of body weight rendered the animal non-susceptible to infection with streptococci. A shorter series of injections with a slightly larger dose answers the same purpose. The drug showed such efficiency that the author applied the same treatment to patients threatened with septic processes, and he reports

a few illustrative cases to show the efficacy of intramuscular injections of the drug in the prophylaxis of sepsis. Once developed, the septic affection is not modified by the small doses which he recommends. A woman of 29 who had chills and a temperature of 39.1° C., pulse 128, and dry skin, and was very restless and thirsty on the third day after delivery, was given 3 injections of 0.01 Gm. ($\frac{1}{4}$ grain) of mercuric benzoate in the course of three days, under which the temperature and pulse subsided to normal. In another case with similar symptoms after an induced abortion the mercury was not commenced until after the fourth day, and the patient died. The writer lays stress on the importance of sterilizing the blood while this is still possible. Krohl (Berl. klin. Woch., Oct. 20, 1913).

Nutrition.—Many years ago Liégeois was led to conclude that even in healthy men very small doses of mercury lead to an increase of weight. Schlesinger, in a series of experiments in sheep, rabbits, and dogs, also noted this fact. Having administered mercuric chloride for an entire year, he found that all the animals, especially the dogs, treated had gained in weight and that there had been a marked increase of red corpuscles, while none of the untreated control animals presented similar changes. There is much clinical testimony, moreover, to sustain the assertion that minute doses of mercury benefit nutrition. The fact that von Boeck found an increase—though slight—of nitrogen in the feces and urine under mercury tends to corroborate this.

Absorption and Elimination.—According to Conti and Zuccola, mercury, by whatever route introduced, is taken up by the leucocytes and transported thereby to various or-

gans, principally the liver, intestines, and kidneys. The liver appears to store it up, while the intestines and kidneys eliminate it. It is only inconstantly to be found in the glands, and is present there only when the system is oversaturated with it. It is always found by preference in the nuclei of the cells.

Ullmann, administering insoluble salts of mercury, found the metal deposited in the following organs, those containing the larger amounts being given first: kidneys, liver, spleen, intestinal canal (containing an increasing amount from above downward), heart, skeletal muscles, and in some cases lungs, and blood collected in the great vessels.

The elimination of mercury depends upon the manner in which it has been administered. Byasson and Betelli found mercury in the urine and saliva two hours after ingestion. After intravenous injection it may be detected in the urine within an hour, but after inunction may not appear for twenty-four hours. Riederer obtained, from the feces of a dog, 77 per cent. of the quantity administered during thirty days, and from its urine 1 per cent.

Mercury is likewise eliminated by the salivary glands, stomach, liver, and skin, and has also been found in the milk of nursing women, in their sucklings, and in semen. The experiments of Magençon and Bergeret tend to show that a single dose of mercury is completely eliminated in a relatively short time. It is known, however, that after the ordinary type of mercurial treatment in syphilis the metal may be found in the urine for months and at times years after the last dose taken.

Mercury found in the urine of dentists who had been working with amalgam fillings; one dentist had 3.4 mg. to the liter of urine. Blomquist (*Hygeia*, Apr., 1913).

After poisoning a rabbit with mercury, the writer found the metal in the blood and lymph; also in the walls of the intestine, in the state of insoluble sulphide. This is due to the action of hydrogen sulphide in the intestine on the metal. The granules of mercury may be carried by the leucocytes between the epithelial cells of the intestine. Other granules are found in the walls of the blood-vessels. If these granules are numerous enough to obstruct the circulation, they may cause necrosis and ulceration. The amount of mercury sulphide precipitated is not proportional to the amount of mercury introduced, but to the amount of hydrogen sulphide in the intestine. Almkvist (*Nord. Med. Arch.*, Nov. 6, 1903).

UNTOWARD EFFECTS AND POISONING.—Mercurial Salivation and Accompanying Phenomena.—

When there exists in the individual treated an unusual sensitiveness to mercury or the drug is given too long or in excessive quantities, symptoms appear that are quite pathognomonic. There is, at first, disagreeable metallic taste, the breath becomes fetid,—the fetor of dead tissue,—the gums are sensitive, and when the jaws are forcibly closed slight pain is experienced. At the same time the salivary flow becomes more free than usual. If the administration of the drug is not stopped as soon as these symptoms appear, the gums become spongy and bleed easily, the tongue swells, and the flow of saliva becomes very excessive,—ptyalism. If the gums be examined, a dark line will be found at their junction with the teeth. The parotid and maxillary

glands are usually enlarged and tender, and there may be slight fever, albuminuria, and oliguria. Frequently in rabbits, less often in man, glycosuria is evoked by prolonged use of mercury.

Persistence in the use of mercury after these manifestations is followed by local destructive changes. Ulceration of the mucous membrane, soon invading the deeper tissues; looseness and loss of the teeth, necrosis of the jaw bones, and copious hemorrhages occurring because of ulceration of the vascular coats follow in more or less rapid succession, and the patient dies of exhaustion. It is rare that such a result occurs nowadays. The cases of mercurial poisoning usually met are due, as a rule, to insufficient instructions to the patient, who continues to use the remedy without consulting his physician. Salivation is produced with particular ease in cases with nephritis; a single grain of calomel may induce it in such patients.

Attention called to the danger of injecting insoluble preparations of mercury in the treatment of syphilis. Report of a fatal case of gangrenous stomatitis due to injections of gray oil. This was the tenth case of gangrenous stomatitis so produced which has come under the author's observation in a few years. Eight of the cases were fatal, and of the surviving patients 1 lost part of his maxilla and the other had not recovered at the end of a year. Gaucher (*Soc. des Hôpitaux de Paris*; *Lancet*, Aug. 7, 1909).

In a case of slight mercurial stomatitis the author observed throughout both jaws, but especially opposite the incisor teeth, a violaceous-gray line 1 to 2 mm. thick on the gums at the insertions of the teeth. The line followed the undulating margins

of the gums and passed between the teeth. This line occurs especially in mouths which are well cleansed in order to prevent stomatitis. In stomatitis of medium intensity it sometimes occurs, but only in an incomplete form. Once formed, the line may last several months in spite of careful treatment and cessation of mercury. G. Milian (*Progrès méd.*; *Lancet*, Jan. 15, 1910).

Case of a syphilitic woman who had been given 2.75 c.c. (44 minims) of 50 per cent. gray oil during a period of one month, the first injection being 0.5 c.c. (8 minims). She had lost 11 teeth. Much of the right alveolar process was denuded. A dentist had removed several pieces of bone with the teeth. The mucous membrane was bluish in color, but not ulcerated, except around the teeth and alveolar process. There was an excessive flow of saliva, which had continued six weeks. The patient had lost about 40 pounds in weight, and the skin had a transparent, bluish tinge.

The cavities in the jaw were washed with **sodium bicarbonate solution** and packed with **iodoform gauze**, the mouth syringed frequently with soda solution, and the dressings changed twice daily. The patient took **potassium iodide** and **tincture of iodine** was painted on the gums.

The urine showed a heavy ring of albumin, some coarsely granular casts, pus, and epithelial cells. All bowel movements were watery and contained shreds of mucous membrane. The heart was found dilated, with very weak sounds, and **digitalis** ordered. The patient gradually grew weaker, and died after a slight exertion in rising in bed. T. E. Carmody (*Denver Med. Times*, Feb., 1913).

In some cases the skin is first to show the mercurial manifestations, an eruption resembling that of scarlatina being most frequently observed. Great suffering is sometimes entailed by a burning sensation of the

skin, which may be markedly swollen and later exhibit abundant desquamation, at times extending even to the hairy scalp and mucous membranes. Absence of fever and throat inflammation are features distinguishing the condition from scarlet fever. Where mercury has been applied externally, the eruption may start at the point of application and then extend elsewhere. The duration of mercurial eruptions is usually one to three weeks, at times longer.

Case of a healthy woman of 32 who gave a history of having suffered at her previous confinements from an eruption of the lower abdomen, inner surface of the thighs, and around the anus, which she attributed to the use of corrosive sublimate for cleansing the parts. Care was, therefore, taken to avoid mercurial preparations for sterilization purposes. After the child was born, however, and before the placenta had been removed, the midwife sterilized her hands in a solution of 1:1000 mercury oxycyanide, and then expressed the placenta. The same evening the patient complained of a smarting in the region of the umbilicus, and a patch of erythema was noticed corresponding in position to the place when the midwife's hands had rested when applied to the fundus uteri. Next day the affected skin was red and slightly raised, with minute vesicles scattered over it. The fluid was at first colorless, but gradually became turbid and yellow. Itching was present. The erythema faded gradually after the third day. Tissier and Corpechot (*Progrès méd.*; Hospital, Oct. 22, 1910).

Anorexia, epigastric discomfort, nausea, and diarrhea, sometimes alternating with constipation, are other manifestations of mercurial poisoning.

In working with a respiration chamber in which the exit tubes were closed with mercurial valves, the

authors observed several instances of poisoning of the men experimented on. The symptoms were usually nausea, increase of pulse rate and respiration, and in most cases rise of temperature. Some difference in susceptibility was shown, as some individuals showed no symptoms after a long stay in the respiration chamber. Carpenter and Benedict (*Amer. Jour. of Physiol.*, May, 1909).

Some patients will never manifest any evidence of mercury in the form of stomatitis, and the first evidence of poisoning one has is a profound and acute nervous prostration. Hay (*Jour. Amer. Med. Assoc.*, Aug. 28, 1909).

A middle-aged man took calomel when he was feeling unwell in a very unusual dose—1 grain (0.065 Gm.) every half-hour for 11 doses. The gastric and intestinal secretions were not in the usual condition of a person in normal health (there was hyperchlorhydria). The drug was not eliminated, but remained in the circulation or tissue cells and resulted in a profound dyscrasia. The red cells descended to 1,252,000 and the hemoglobin to 19 per cent.; at this point the tide turned and the patient made a good recovery. Fever, rapid pulse, a heart murmur, and general weakness, suggesting septic endocarditis, were noted. There were no marked evidences of salivation.

Another case was that of a woman who after a single douche of a solution of bichloride of mercury in the strength of 1:5000 developed typical symptoms of corrosive chloride poisoning. After all traces of hemorrhage from the mucous membranes had ceased, the red cells and hemoglobin continued to fall progressively day after day in spite of all treatment, until they finally reached 1,200,000 red cells, hemoglobin 17 per cent., at which point the patient expired. W. G. Elmer (*Therap. Gaz.*, Sept., 1910).

Fatal case of poisoning from an injection of a 50 per cent. ointment

of mercury in hydrated wool-fat. It was ascertained afterward that the patient was being treated for chronic nephritis. Stress laid on the importance of bearing in mind, whenever mercury is used, especially in hypodermic form, the need of repeated examination of the urine. T. J. Harris (Amer. Jour. of Dermat., May, 1911).

Case of a man who, having been ordered to take pills of bichloride of mercury for two weeks after an operation for glaucoma, continued to take them for four months, the daily dose being $\frac{1}{6}$ grain (0.01 Gm.). Ulcerative colitis developed with diarrhea, and the patient succumbed in the fifth month to the results of perforation of an abscess in the rectum. There had not been any marked subjective disturbances at any time—no stomatitis—and all the organs appeared intact except the large intestine. Cobliner (Arch. f. Verdauungskrankh., Aug., 1911).

Case of unusual sensitiveness of the colon to mercury. The author, while treating a case of eczema, gave a course of salicylate of mercury injections. A 10 per cent. suspension in liquid petrolatum was used. On the morning after an injection of 15 minims (1 c.c.) into the buttocks, the patient suffered from severe tenesmus and bloody stools, with intense pain across the abdomen below the navel. About a week later a second injection was given with similar results. Montgomery (Jour. Amer. Med. Assoc., Mar. 23, 1912).

Besides the symptoms of mercury saturation which have been called "mercury gripe"—gastric distress and stomach or bowel disturbances which yield readily to an oil purge—the author has met with 4 cases in which mercury caused symptoms suggesting angina pectoris. In 1 case the pain was so intense as to cause syncope. The urine showed a little albumin, the pulse ran up, and the temperature also rose slightly. This pseudoangina pectoris was observed

twice in the course of treatment in 3 cases; it followed the fourth, sixth, or ninth injection in 3 cases, and the first in 1 case. The mercury can be continued without fear of further trouble after waiting two weeks. Albuminuria calls for reduction of the dose of mercury, but skin manifestations are generally due to special idiosyncrasy. Ragusin (Semana Medica, Sept. 5, 1912).

The author found in the literature since 1883 records of 108 fatalities from the use of mercury. In but 1 case had it been given by mouth (5 pills of 0.06 Gm.—1 grain—each). One fatality was credited to inhalation of mercury, 9 to mercurial oil, 10 to mercuric salicylate (in 1 case a single injection of 0.05 Gm.— $\frac{1}{2}$ grain—proved fatal), 7 to injection of the soluble preparations, 48 to injection of insoluble, 31 to gray oil, and 19 to inunctions. Stress laid on previous urine examination, and repeating once a week. Wolfenstein (Berl. klin. Woch., Oct. 13, 1913).

In an infant 18 months old, a 10 per cent. *mercurial salve* was applied for two weeks to patches of eczema back of the ears. Then the dermatitis rapidly became universal and severe nephritis developed with high fever, albuminuria, dyspnea and diarrhea. The latter was kept up with compound licorice powder, half a teaspoonful three times a day, and improvement gradually followed. Lomholt (Ugeskr. f. Læger, May 3, 1917).

Treatment of Salivation.—The prophylaxis of "ptyalism" consists in having **carious teeth attended to** before mercurial treatment is begun, and in maintaining scrupulous **cleanliness of the mouth** during its entire course. A mouth-wash consisting of saturated **potassium chlorate** solution, with, perhaps, a little **tincture of myrrh** added, is recommended both for prophylactic and curative purposes. Where salivation definitely makes its appearance the **mercury**

should be discontinued or the dose greatly reduced.

Atropine may be given to arrest the elimination of the drug in the mouth, and an astringent mouth-wash containing **tannic acid** is also appropriate. Purging with **magnesium sulphate** may be of advantage.

Stomatitis or *gingivitis* is of very frequent occurrence unless the teeth and gums have been carefully attended to from the beginning of the course of treatment. The teeth should be brushed after every meal; to avoid lacerating the gums, a small **toothbrush of badgers' hair** should be employed. As a mouth-wash the author orders either **hydrogen peroxide**, 5 vols., or a lotion containing **liquor alumini acetotartratis** (Ph. Germ.). The mouth-wash should be used every one to two hours; a small flask holding enough for the day's use may be carried in the pocket.

Diarrhea is not likely to arise unless there has been great indiscretion in the diet. Should it occur, the onset is sudden, severe, and associated with much wind and blood-stained stools. The treatment consists at once in giving 25 drops of **tincture of opium**, to be repeated in three hours if necessary, the administration of **mercury**, of course, being **stopped** for a few days. D. Freshwater (Lancet, Aug. 10, 1912).

CHRONIC MERCURIAL POISONING.—When mercury is inhaled in the form of a vapor, as by workers in thermometer, mirror, and hat factories, and in mercury mines, the nervous system is most apt to suffer, and paralysis is a frequent sequel. The palsy may, after long exposure, come on either suddenly or slowly. Leyden, Spillmann, and others have recorded cases of pronounced multiple neuritis resulting from the therapeutic use of mercury. There

is a species of general tremor and great unsteadiness in all movements, including those involved in locomotion, and the skin becomes dark yellow or brown. Mercurial "erethism," manifested in unusual irritability and timidity, with marked motor weakness and at times delirium, is a characteristic feature. Mental debility may appear, the precursor of an early demise. The manifestations often simulate chorea and paralysis agitans. The disease may assume various special forms, certain parts being more involved than others. In some cases wrist-drop is a feature; in others there may be a brachial or crural monoplegia, etc. Wasting of the muscles, however, does not occur, and the reaction of degeneration is absent. The special senses are often impaired (anosmia, deafness, amblyopia), and disorders of sensation are frequently observed. Neuralgia is a prominent feature. According to Gilbert, a blue line on the gums, very similar to that found in lead poisoning, may be present.

Description of the chronic and usually rather mild form of mercurial poisoning which develops in those manufacturing felt hats. The portal of entry for the mercury varies with the process in which the individual is engaged; it may be the respiratory tract, buccal mucosa, bad teeth, or abrasions on the hand. The mouth shows: slight salivation; tongue large, flabby, and dove-colored or silvery; teeth blackened, especially near the crowns; there is usually some pyorrhea. These changes are most marked in smokers and those who chew tobacco. The edge of the gum is often cyanosed. Many first complain of a tremor, rather fine, rapid, and of irregular amplitude. It is generally increased on voluntary movements, stops dur-

ing sleep, and is much less when lying down. It may be more marked on one side than on the other, and may often be easily detected in the handwriting. Some of the patients experience difficulty in locomotion. Treatment consists in rest in bed, small doses of **potassium iodide**, and **abandonment of the occupation**. Tylecote (Lancet, Oct. 26, 1912).

Mercurial cachexia, the later stage of chronic poisoning, resembles scurvy and may result either from vocational exposure to the effects of mercury or as a sequel of treatment. There is marked anemia and loss of flesh, alopecia, a general loss of power, and all the local manifestations of mercurial toxemia,—foul breath, diarrhea, and a dark color of the skin. There are, besides, intense aching in the bones and joints suggesting rheumatism, and a tendency to syncope, circulatory weakness, and disturbed sleep. The diagnosis may be confirmed by detection of mercury in the urine or feces.

Method of examining for mercury in the urine described. It consists of 1 drop of egg albumin to 5 c.c. of filtered urine, agitating and adding 3 c.c. of a 12 per cent. solution of tin chloride just filtered and acidified with 25 per cent. of hydrochloric acid. Turbidity, clarification, and opalescence follow. The urine is then centriuged and the precipitate examined under 600 magnification. Metallic mercury, if present, will be seen in the form of extremely minute, black globules. Lombardo (Jour. of Cutan. Dis., Jan., 1908).

New test for mercury described. In dealing with urine about 150 c.c. is taken, acidulated with 5 c.c. of concentrated hydrochloric acid and evaporated over a free flame until the bulk has been reduced to 25 or 30 c.c. About 2 c.c. of hydrochloric acid is added to replace the loss by evaporation, and also enough potassium

chlorate to oxidize thoroughly the organic material present. This usually requires about 2 Gm., and when it has been effected the fluid becomes pale yellow or colorless. It is then diluted to about 60 c.c. and boiled vigorously until the chlorine previously evolved has been driven off, which is shown by the absence of chlorine odor from the steam. A piece of copper wire about 4 cm. in length, bent back on itself twice and cleansed by boiling a short time in a test-tube with dilute hydrochloric acid, is dropped into the solution and allowed to remain for an hour or more. If considerable amounts of mercury are present it will then be found coated with a silvery film of metallic mercury. This is not altogether sufficient if the quantity is small. The wire then is removed, washed, dried, and next allowed to slip into a tube sealed at one end and followed by a cylindrical plug of dentists' gold leaf. The end of the tube containing the wire is then heated in a Bunsen flame or that of a spirit lamp, care being taken to avoid heating the part containing the gold leaf. If there is an exceedingly minute amount of mercury present there will simply be a pale discoloration of the gold, but if the amount is larger the silvery patch will be easily seen. In doubtful cases the experiment should be repeated, using larger quantities and more time in the solution. Further to confirm the identity of the mercury, the gold foil may be suspended in a tube containing a few crystals of iodine, which are then gently warmed, the mercury being changed to red mercuric iodide. In testing stomach contents or feces the same method is employed, though usually with smaller amounts. In this test a definite positive reaction is yielded when a solution containing 0.00002 Gm. of mercury in the dilution of 1:1,000,000 is used, and the wire allowed to remain in the solution three hours. Kogel and Lee (Jour. Amer. Med. Assoc., Feb. 14, 1914).

Treatment of Chronic Mercurial Poisoning.—Prophylaxis consists in careful attention to hygiene on the part of those exposed to mercurial vapor. The workmen should labor under hoods and drink freely of water. In developed poisoning the victim should be **removed from exposure** to mercury, **sweat baths** and **potassium iodide** taken, and suitable treatment applied for the nervous condition, anemia, and salivation.

ACUTE MERCURIAL POISONING.—Whatever preparation of mercury be ingested in poisonous quantities, the symptoms are very similar, the only noteworthy difference being the rapidity of onset. The majority of accidental cases met with are instances of mercury bichloride poisoning. If the dose taken is large and concentrated, there follow nausea, vomiting, faintness, impaired locomotion, severe pain in the mouth, throat, and stomach, and at times sensation of constriction in the chest. There is violent diarrhea, with cramps. At first the urine is freely voided; later, anuria occurs. The lips, tongue, and pharynx may be tumefied, and dysphagia be so marked as to prevent swallowing of remedies. After several hours the breath becomes fetid, salivation occurs, and ulcers appear on the inner aspect of the lips and cheeks and sometimes on the tongue. The gums become spongy. Tremor may be noted. Gradually the local and general symptoms become more marked. The pulse becomes small and sometimes irregular, the respiration rapid and shallow, the skin cold and clammy, and the features pinched. Only occasionally is somnolence or restlessness observed. Anuria may

set in within a few hours. Death has been known to take place within an hour from shock, but oftener there is survival for some days or even weeks, the victim finally succumbing to renal failure, to exhaustion from the dysenteric manifestations, or to cardiac dilatation.

Case of transient but severe pericarditis, without effusion or fever, after ingestion of 1.3 Gm. (20 grains) of mercury bichloride. The pericarditis became evident about the tenth day and persisted for three weeks. Petit and Milhit (*Presse méd.*, Aug. 12, 1908).

Case of a healthy girl aged 17 who was found sitting on the floor and leaning against her bed, with eyes fixed and staring, and face with a purple tinge. She was nauseated and was coughing and expectorating blood-flecked mucus and saliva. She died in less than five minutes after being found. Fifteen minutes before, she had been seen playing with a pup, so that less than twenty-five minutes had elapsed before death. She had taken no food or drink that morning. Examination of the stomach contents revealed mercury in moderate amount. F. E. Jones (*Boston Med. and Surg. Jour.*, Feb. 3, 1910).

Case of a patient who had taken in solution 45 grains (3 Gm.) of mercuric chloride. She vomited freely within five minutes, her **stomach** was **washed** at the end of thirty minutes, and in the interim she drank the **whites** of half a dozen **eggs** and two glasses of **sweet oil**. At the end of an hour she became unconscious. Urine drawn by catheter for the first time at the end of sixty-two hours was scanty and bloody. **Nourishment** was given **by rectum**, everything given by mouth being vomited. A diffuse papular rash appeared over the body at the end of the first day and at the end of the second the teeth were black and extremely loose and exuded pus around the margins.

A large abscess formed on the left side under the bicusps, and coincidentally there was an acute otitis media, with intense pain over the back of the head and neck. The eardrum ruptured and there was complete loss of hearing on the left side. The alveolar process on both sides necrosed and a large number of sequestra were removed. The patient finally recovered, but still suffers from anemia, weak heart, and nephritis. A number of the teeth dropped out or were removed by the patient. Herzstein and Boer (*Jour. Amer. Med. Assoc.*, Mar. 23, 1912).

Case of a female aged 22 who swallowed 3 white bichloride tablets of 7.3 grains (0.5 Gm.) each. About ten minutes afterward the **stomach** was **emptied** by tube, and repeatedly **washed, with egg and milk**, for one-half hour. There were no signs of collapse. She was discharged on the twenty-fourth day as cured.

The treatment followed consisted of **hot packs, wet cuppings over kidneys, saline instillation per rectum, pilocarpine** in $\frac{1}{4}$ -grain (0.016 Gm.) doses, **bismuth subnitrate**, and occasionally **tincture of opium, Vichy, and milk**. After kidney action was established **potassium citrate** was given in 10-grain (0.6 Gm.) doses, four times daily.

Interesting points in the case were: (1) Anuria for over five days, save for the passage of 10 drops in the ninetieth hour; (2) temporary presence of sugar in the urine for nine days; (3) bluish discoloration of the fingers, toes, urine, and vomitus, without the ingestion of anything containing methylene blue. J. M. Lobsenz (*N. Y. Med. Jour.*, July 26, 1913).

According to Söllmann, the lethal dose of mercuric chloride is 3 grains (0.2 Gm.). Bunting points out that mercurous chloride (calomel) is very inconstant in its action as a poison. Six grains (0.4 Gm.) have proven fatal, while 1 ounce (30 Gm.) has

been taken with impunity. Rungberg records a case in which 3 injections of $1\frac{1}{2}$ grains (0.1 Gm.) each, given within a month, proved fatal. These variations would seem to support the theory that calomel acts only by partial conversion into the bichloride, the extent of its poisonous action, therefore, depending upon varying factors such as the degree of acidity of the gastric juice. Recent observations, however, do not support this. Pouchet asserts that the bromides and chlorides are powerless to convert calomel into corrosive sublimate, such a change occurring only upon contact of calomel with the alkaline iodides.

The writer found in the literature 14 fatalities from the therapeutic use of calomel, death occurring in from three to forty-two days after a total dose of from 0.3 to 2.6 Gm. (5 to 40 grains) in 7 cases, and in the others after a total dose of from 2.4 to 4.6 Gm. (37 to 70 grains). The production of bile is diminished after calomel, and the drug has an irritating action on the kidneys. Chodounsky (*Wiener klin. Woch.*, Apr. 7, 1910).

Case of a man 85 years of age who swallowed $8\frac{3}{4}$ grains (0.55 Gm.) of bichloride of mercury. At once recognizing his error, he drank a tumblerful of **barley water**. Seen half an hour later, he was given **white of egg**, and brought up blue-stained mucus from the indigo in the bichloride tablet. The **stomach-tube** was then passed and the **stomach washed out** with large quantities of **albumin water** and **milk** and water. There was an urgent desire for the bowels to move, but little more than mucus was passed. The patient collapsed, was cold and pallid, and the pulse was almost imperceptible. **Strychnine** was given hypodermically and **milk and brandy** by the mouth. The next morning he was somewhat better. For several

days the bowels continued to be very irritable, but after a slow convalescence he quite recovered from the effects of the poison. Fuller (*Brit. Med. Jour.*, Jan. 18, 1913).

In a fatal case, that of a woman who had taken upon an empty stomach a large teaspoonful of corrosive sublimate in powder form, Durante found the following pathological changes: Subpericardial ecchymoses; enlarged liver, with subcapsular ecchymoses; pale, swollen kidneys, with small ecchymoses in the pelves; esophagus reddened at its upper part, normal below; stomach showing a softened mucosa, with numerous ecchymotic patches and large, grayish ulcerations, most marked near the fundus; intestinal mucosa showing limited areas of deep reddening, with ulcerations, the changes in the large intestine being less than those in the ileum; brain showing injection of the vascular meninges.

In an illustrative case reported by R. L. Dixon the renal tissue showed a large amount of lime salt deposit, a consequence of decalcification of the bones, as noted especially in the sternum; the case also showed a marked congestion of the hemolymph-nodes in the retroperitoneal tissue.

Local applications of various preparations of mercury are no less toxic than when the drug is taken by the mouth. Sackur reports the case of a girl aged 20 who sprained her wrist. A few days later lymphangitis apparently supervened, for which mercurial ointment was applied and rubbed into some cracks on the hand. An hour after the inunction the patient felt ill, fainted, and vomited. The same evening there was much

swelling of the hand and of the arm on its dorsal aspect. An incision was at once made. On the succeeding days there occurred vomiting, tenesmus, albuminuria, anuria, blood-stained stools, gangrenous gingivitis and glossitis, prostration, paralysis of the extremities, and death.

The recommendation of preparations of mercury for vaginal douching is attended with danger, owing to the large quantity of fluid injected. Rectal injections are still more dangerous, owing to the rapidity with which fluids are absorbed.

Report of 3 cases in which patients had been instructed to "use" bichloride tablets. Each of them inserted 1 tablet in the vagina. Although medical assistance was obtained within twenty to thirty-five minutes the patients died, respectively, four, fourteen, and seven days later. It would appear that a fatal amount can be absorbed from the vagina within twenty minutes. The patients were unable to remove the tablets themselves because of severe spasm and pain. C. B. Schildecker (*Amer. Jour. of Obstet.*, Mar., 1911).

Case of mercuric chloride poisoning with ptyalism, stomatitis, urinary suppression, vomiting, etc., following vaginal hemorrhage treated by tampons soaked with bichloride solution, applied to bleeding cervical lacerations some days after confinement. Bichloride solution (1:4000) douches were also used, though the nurse claimed that the second of the two douches was only sterile water. The case shows that a combination of conditions is possible under which poisoning may occur from a vaginal douche given a whole week after labor. The patient was recovering from the poisoning when she was taken with bronchopneumonia and edema of the lungs, which carried her off three weeks after the poisoning. J. M. Mabbott (*Jour. Amer. Med. Assoc.*, Aug. 5, 1911).

Case of poisoning from vaginal douches of mercuric chloride solution, 1:1000 to 1:2000 strong, used to prevent conception. Beekman (Jour. Amer. Med. Assoc., Feb. 14, 1914).

Case of woman who exhibited a violent reaction to injection into the nose, to act on the lacrimal sac, of 1 c.c. of a 1 per 10,000 solution of mercuric chloride containing a little adrenalin. Possibly her recent conception may have increased the susceptibility. Cjessing (Norsk. Mag. f. Laegevid., Mar., 1918).

Sajous has pointed out that mercury is a powerful adrenal stimulant. The addition of adrenalin, and the stimulation of the adrenals resulting from the conception plus the mercury, account for the toxic phenomena. EDITORS.

Treatment of Acute Mercurial Poisoning.—The whites of several eggs should at once be administered, in order to form non-corrosive albuminates with the mercury. Complete precipitation of the mercury is not to be relied on, however, and the stomach should be evacuated soon after and washed out, using a stomach-tube. In the absence of the latter, emesis may be resorted to. As soon as the stomach has been well evacuated more white of egg should be administered and left *in situ*. If no eggs can be had milk or wheat flour may be used, the latter being given with a little water—just enough to enable it to reach the stomach promptly. Finely chopped beef might likewise be used. Non-irritant oils and other demulcents should be administered to soothe the irritated mucous membranes. The remaining symptoms are to be treated on general principles as they appear. Opium may be required to relieve pain and tenesmus. Nephritis and colitis should be treated by the measures

ordinarily employed in these conditions. Where the oral cavity is foul, a solution of hydrogen dioxide may be employed with advantage.

Renal decapsulation has been attempted in a few cases of bichloride poisoning with anuria. Success was had in re-establishing the renal function and forestalling fatal uremia, but the patients eventually succumbed to the other pathological conditions induced by the poison.

Sodium thiosulphate by mouth has been recommended by Salvatani; calcium sulphide by mouth and intravenously by Wilms, and magnesium oxide, 30 to 60 grains (2 to 4 Gm.) every 3 hours with plenty of water, by Schisler.

In a study of 141 cases of mercury poisoning, neutralization by magnesium oxide and sodium bicarbonate proved best, not only on account of its simplicity but also from the excellent results obtained by its use, namely, 92 per cent. of cures. The magnesium oxide is given in doses of 32 to 60 grains (2.1 to 4 Gm.) every 3 or 4 hours. This method has been used in conjunction with gastric lavage, milk and eggs, and the administration of 70 to 100 c.c. (2½ to 3½ ounces) of a saturated solution of magnesium sulphate as emergency treatment, followed by stimulation or sedatives as indicated. Brashear (Med. Council, Mar., 1920).

The Lambert and Patterson treatment, consisting of alkalies, gastric lavage, colonic irrigation, and daily hot packs, has greatly improved the results in these cases.

In bichloride poisoning the writers wash out the stomach twice daily and also give 2 colonic irrigations daily. A liquid diet of 8 ounces of milk every 2 hours is given to be alternated every 2 hours with 8 ounces of the following mixture: Potassium bitartrate, 1 dram (4 Gm.); sugar, 1

dram; **lactose**, $\frac{1}{2}$ ounce (15 Gm.); **lemon juice**, 1 ounce (30 c.c.); **boiled water**, 16 ounces (500 c.c.). A solution containing 1 ounce (30 Gm.) of **potassium acetate** to the pint (500 Gm.) of water is also given continuously by rectum. The patient receives a daily hot pack. Among 16 cases thus treated there were but two deaths. Lambert and Patterson (Arch. of Internal Med., Nov., 1915).

Alkali and hypertonic salts by mouth, by rectum and intravenously—a treatment based on Fischer's principle of acid colloidal swelling of the renal cells in nephritis, is recommended by the writer. The solution used by mouth consists of **potassium bitartrate**, 1 dram (4 Gm.); **sodium citrate**, 30 grains (2 Gm.); **sugar**, 60 grains (4 Gm.), with **lemon** or **orange juice** to taste, to 8 ounces (500 c.c.) of water. Intravenous injections of **Fischer's solution**, consisting of **sodium carbonate** crystals, $2\frac{1}{2}$ drams (10 Gm.) and **sodium chloride**, 4 drams (15 Gm.) to 1 quart (1000 c.c.) of water, are also given. On admission the stomach is washed with 1 quart (liter) of milk and the **whites of 3 eggs**, followed by water. Before the tube is removed, 3 ounces (90 Gm.) of **magnesium sulphate** in 6 ounces (180 c.c.) of water are introduced. A **soapsuds enema** is then given. If the patient did not vomit promptly after swallowing the poison nor receive medical aid for 3 hours, 16 to 24 ounces (1000 to 2000 c.c.) of Fischer's solution is given intravenously. Six to 8 glasses of the alkaline solution are given by mouth daily, with plenty of water and a liberal diet. Of 28 patients thus treated, but 1 died. H. B. Weiss (Jour. Amer. Med. Assoc., June 2, 1917).

In a case of mercurial poisoning in a young man, disorders manifested mainly by gastrointestinal vomiting, diarrhea and Cheyne-Stokes dyspnea with a sensation of chest oppression and anuria, the writer gave an intravenous injection of a **hypertonic glucose solution**, 60 Gm. (2 ounces) of glucose in 200 c.c. ($6\frac{1}{2}$ ounces) of

distilled water. The improvement was striking, 120 c.c. of urine being passed within 1 hour after the injection and the output of the 2 succeeding days being 825 and 1800 c.c. respectively. Milian and Mougenc de Saint Avid (Paris Méd., Sept, 8, 1917).

THERAPEUTICS.—Metallic mercury is mainly employed as a cathartic in the form of blue pill. As such it is an excellent agent when **hepatic torpor** appears to exist, though it sometimes proves irritating to the intestinal tract. Nine grains, or three 3-grain (0.2 Gm.) pills, usually give rise to little, if any, griping. If this symptom is feared, however, a little opium may be added. A saline purgative is given the next day.

In cases of **heart disease** with general edema Pepper strongly recommended a pill containing 1 grain (0.06 Gm.) each of blue mass, digitalis, and cinchonidine sulphate.

Mercury with chalk, or gray powder, possesses much the same properties as blue mass, but it acts more mildly and is, therefore, considerably used in the treatment of children suffering from **hepatic atony** and the **intestinal conditions** associated therewith. The antacid power of the chalk adds to its value in the treatment of **infantile diarrhea** with watery, colorless stools. It is also used in **infantile syphilis** with success, especially in syphilitic marasmus.

Mercurial ointment, besides its well-known value in the treatment of **syphilis** (*q.v.*), is also employed as an antiphlogistic and resolvent in **joint inflammations**. It is especially valuable when **effusions** and **ankylosis** are feared as a result of the local changes.

It is also considered of value by some to check serous effusions in **pleurisy**, **pericarditis**, and **peritonitis**,

as well as to promote healing in these conditions. The same may be said of **orchitis** and **epididymitis**, **glanders**, and other surgical mycoses.

Mercurial ointment has also been considerably used in the treatment of **pediculi** or other parasites of the hairy regions of the body; but as Leidy showed, any fixed or volatile oil or even a bland ointment will act as effectually. Hence mercurial ointment should only be employed after trying the less dangerous preparations. If it is used, care should be taken to avoid salivation.

Mercurial plaster may be used in the same disorders as the ointment and with the same objects in view. It is especially valuable in the treatment of **splenic enlargements** of **malarial** origin. It is also used to prevent pitting in **small-pox**.

Oxides of Mercury.—The yellow oxide of mercury is too irritating for internal administration, and is mainly employed to prepare the corresponding 10 per cent. ointment. Even the latter is too strong for use in ophthalmic practice, however, and it is usually reduced by the addition of lanolin, lard, etc. According to T. E. Mitchell, the following method of preparing the ointment of yellow oxide is preferable to that officially prescribed, the mass produced being more thoroughly homogeneous:—

℞ *Olei ricini* gtt. iv (0.24 Gm.).
Hydrargyri oxidi
flavi gr. iij (0.2 Gm.).
 Misce et adde:—
Petrolati ʒij-iv (8-16 Gm.).

The red oxide of mercury is employed to prepare the corresponding ointment, but the latter is advantageously replaced by the ointment of the yellow oxide, owing to the

finer grain of the powder obtained with the latter.

Black wash and yellow wash, considerably used as local stimulants, depend for their virtues upon the black and yellow oxides formed.

The yellow oxide of mercury enjoys the confidence of ophthalmologists in the treatment of **blepharitis** and **conjunctivitis**. In the acute form of the latter disorder an ointment containing 3 to 4 grains (0.2 to 0.25 Gm.) of the yellow oxide to the ounce (30 Gm.) is sufficiently strong, while disorders of the lids usually require a preparation of four times that strength. The ointment should not, however, be allowed to come into contact with the conjunctiva. **Corneal opacities** and **ulcers** are also favorably influenced by the continued application of an ointment of yellow oxide of mercury.

Among affections of the skin the yellow oxide has been used with advantage in **eczema** and **acne**. **Erythematous pruritus** of the **anus** is quickly arrested by its use.

The red oxide is mainly used to stimulate **obstinate ulcerative processes**, such as those occurring in venereal disorders. It is also employed in **parasitic diseases of the skin**. Morain recommends a 2:15 ointment of red oxide in petrolatum in **anal pruritus**, while Elliott has found the following combination very useful in **acne** where much pustulation exists:—

℞ *Ung. hydrargyri oxidi*
rubri ʒiij (12 Gm.).
Ung. sulphuris ʒvj (24 Gm.).
Ung. zinci oxidi, q. s. ad ʒij (60 Gm.).
 M.

Varicose ulcers of the legs were successfully treated by Langes with

an ointment of 1 part of red oxide of mercury to 18 parts of petrolatum. The dressing was renewed once a day.

Black and yellow wash are also employed to stimulate **chancres** and **syphilitic ulcers**, the yellow wash being far more potent than the black. The latter is sometimes used in **eczema**.

The oleate of mercury is sometimes substituted in syphilis for the much less cleanly agent, blue ointment. It should be rubbed into the tissues in somewhat smaller quantities, and less rapidly. It is also employed in **parasitic skin disorders**, having replaced gray ointment in many of these, especially **tinea tonsurans**, **pediculosis**, and **sycosis**.

Incipient **sympathetic ophthalmia** can sometimes be thwarted by the judicious and persistent employment of mercury.

In **phlyctenular conjunctivitis** and **keratitis** the author prescribes fractional doses of calomel or gray powder, interrupting the course by one of a mineral acid.

In **glaucoma** he commonly employs calomel for a few days, following it with small doses of the red iodide, each to be used in conjunction with saline beverages.

Disturbances in the circulation of the uveal tissues whereby there may be noted sluggishness of iridic action, cloudiness of the aqueous and vitreous, boggiess of the choroid and retina, with undue hyperemia of the optic disk, sometimes in persons who believe themselves to be in perfect health, can be entirely dispelled by a few doses of fractional amounts of calomel.

In **interstitial keratitis** mercury must be exhibited to prevent the serious uveal complications which are likely to occur.

In **iritis** and **parenchymatous keratitis** the following formula is useful

for inunction: Mercury, 3 parts; codliver oil, 5 parts; lanolin, 2 parts. One case of **interstitial keratitis** in a lad of 14 which had resisted all other preparations responded promptly to gray powder, a 1-grain (0.06 Gm.) pill once daily for a week; then 2 pills for four days, and then 3 pills daily.

In **iritis** rapid action can be had by 1-dram (4 Gm.) quantities of mercurial ointment rubbed thoroughly twice or even thrice daily, absorption being increased by the hot-air bath or a prolonged hot bath. It may be necessary to resort to intramuscular injections of the bichloride. To prevent extension to the choroid, the protiodide or biniodide in fractional doses may be used for months.

Syphilitic choroiditis is usually readily amenable to mercury.

In **hemorrhagic retinitis** mercury is of signal usefulness unless organization of the effused material has already taken place.

In **descending optic neuritis**, when the disk appears blurred in outline and dull in color, rapid mercurialization may speedily affect it. Concentric atrophy may be arrested and vision maintained.

In "autotoxic" cases, from absorption of acids generated through imperfect digestion, when there is cloudiness of the humors of the eye, swelling and venous hyperemia of the choroids, retinas, and disks, brisk calomel and saline courses, with continued periods of protiodide, soon effect and maintain clearness. In the **toxic amblyopias**, exogenous or from disturbed metabolism, mercury hastens the elimination of the poison.

Tuberculosis of ocular structures is certainly curable by mercury.

In **phlyctenular conjunctivitis** and **keratitis** the author dusts calomel in the conjunctival sac. In addition, restriction of diet; fractional doses of calomel for three days, followed by salines; then inunctions of mercury in codliver oil daily, and after several weeks thyroid extract, 1

grain (0.06 Gm.) in capsules, are also ordered.

Cases of **keratitis** presumed to be **tuberculous**, but without **phlyctenules**, do well on the same treatment.

In **contusions of the eye** with great extravasation of blood into the chambers prompt mercurialization causes a speedy absorption of the effused blood.

After **removal of eyeballs** because of **purulent infection**, mercury should be given for three or four weeks to prevent the development of **meningitis**. Burton Chance (Therap. Gaz., Dec., 1909).

Ammoniated Mercury.—The ointment of ammoniated mercury (white precipitate) is, next to that of the nitrate, the most irritating of the official ointments of mercurial compounds, and is employed in such affections as **chronic eczema** and **psoriasis**. It is also used in **parasitic skin diseases**, and occasionally as an application to **syphilitic ulcers**.

Nitrates of Mercury.—The solution of acid nitrate of mercury is a very active caustic, instantly penetrating the superficial tissues and especially **phagedenic ulcerations**. When, therefore, it is to be applied, the spot to be touched should be surrounded by a protective covering of petrolatum, and a glass rod used for the application to limit precisely the amount employed. Any surplus should be washed off or removed with blotting paper. It is not infrequently used for the destruction of **syphilitic sores**, **benign** and **malignant neoplasms**, **lupus**, **condylomata**, **noma**, **nevi**, **warts**, etc. Shield has reported a case of complete cure in **lupus vulgaris** from 6 applications of pure nitrate of mercury under cocaine local anesthesia.

Nine cases of **superficial new growths** treated by acid nitrate of mercury as recommended by Sherwell. The procedure consists in local anesthesia by cocaine; complete removal of the growth with curettes or scalpel; hemostasis by cautery if necessary, and, finally, application of the nitrate for fifteen to twenty minutes, followed by sodium bicarbonate to neutralize the excess. The resulting wound is kept clean and dry, the edema and swelling usually requiring no special treatment. The immediate and permanent results, both in benign and malignant growths, are excellent. H. H. Hazen (Wash. Med. Annals, Nov., 1912).

The ointment of nitrate of mercury, or citrine ointment, may be advantageously employed for deep-seated inflammations limited to restricted areas, when the superficial tissues are intact. It was thus successfully used to abort **boils** and **felons** by Kenner, who, in treating a felon, covered the entire finger with a coating of the ointment about $\frac{1}{8}$ inch thick, and then wrapped over it a piece of thick adhesive plaster. This dressing was allowed to remain twenty-four hours, after which no further treatment proved necessary.

In **tinea circinata** the ointment of mercury nitrate is efficient and widely used. When the ointment is to be used in **ulcerative processes**, for which it is employed as an active stimulant, it should be diluted one-half. In this strength it is especially useful in **chronic disorders of the scalp**, and is also occasionally used in **chronic eczema**, **psoriasis**, and other cutaneous disorders of the body, though only when these are localized. Its application over large surfaces is dangerous.

Iodides of Mercury.—The red iodide, or biniodide, of mercury is

used principally in the treatment of **syphilis** (*q.v.*), but it has been found useful in various other disorders, as an antiseptic in surgery, and in infectious diseases.

Illingworth used a 1:2000 solution of mercury biniodide in sodium iodide solution for the dressing of all **amputation flaps** and **recent wounds**, and asserted that union is secured more firmly and rapidly thereby than with phenol dressings. He found it non-irritant.

The same author used the biniodide both internally and locally in **scarlet fever**, with asserted good results both in causing the condition to abate and in preventing its transmission to others. The throat was painted or sprayed every four hours with a 1:2000 to 1:500 solution of the drug.

Hypodermic injections of biniodide of mercury are very effective in **hereditary syphilis**. Children tolerate large doses of strong solutions of the drug, and the writer recommends as an ordinary dose 0.06 Gm. (1 grain) at intervals of five to eight days, according to the severity of the specific manifestations. A perfect solution of the mercurial is obtained by adding a small quantity of potassium iodide, and for this purpose a few drops of the following solution is recommended: Potassium iodide, 1 Gm. (15 grains); distilled water, 4 c.c. (1 fluidram). Subcutaneous injections produce very painful swellings, which do not disappear for some time, and for this reason intramuscular injections are to be preferred. They are somewhat painful, but do not cause as much discomfort as the subcutaneous injections. Breton (*Revue mens. des mal. de l'enfants*, Dec., 1903).

Biniodide of mercury precipitating tyrotoxicon in liquids, it has been recommended as an antidote in **ptomaine poisoning**.

The green or yellow iodide is mainly employed in **syphilis** (*q.v.*).

The solution of arsenic and mercuric iodides (Donovan's solution) is much esteemed in the treatment of chronic disorders of the skin: **leprosy**, **lupus**, etc. It is also advantageous in **chronic gout** and in **rheumatism** as a general alterative and tonic.

Chlorides of Mercury.—*Mercurous chloride*, or *calomel*, is still considerably employed as a **purgative**, though slow in action and occasionally unreliable. The opportunity for retention under such circumstances renders mercurial absorption possible when a large dose is given, and it is always prudent to administer a saline the next morning, or to give another purgative at the same time—a poor recommendation for the primary drug. The compound cathartic pill is based upon this principle. Recent labors have severely shaken the general belief that calomel increases the flow of bile, and tend to confirm the view that as true purgatives there are many agents, *e.g.*, podophyllin, that are preferable to calomel. The latter is advantageous, however, over most other purgatives in having decided antiseptic properties, without inhibiting the digestive ferments. Its germicidal action may render it useful, moreover, in the presence of systemic infectious processes. In **diphtheria**, for instance, it is useful, and will sometimes check the disease when administered,—but this can hardly be credited to its merits as a purgative. According to the experiments conducted by Boyon and Dufour on dogs with bile fistulas, calomel actually exerts a decided inhibitory effect on the secretion of bile.

Sollmann explains the action of calomel in the intestines as being the result of its solution therein, due to its forming albuminates soluble in the carbonates and chlorides of the intestinal juice. The intestine of nurslings containing much less chloride than is present in adults, calomel is less strongly cathartic in the former than in the latter. The dissolution of calomel in the intestine goes on slowly, so that but little of the drug has actually become soluble by the time purgation begins.

Thus it is conceivable why purgative effects are obtainable from calomel with greater certainty and without danger of ptyalism when very small doses, $\frac{1}{10}$ to $\frac{1}{2}$ grain (0.006 to 0.03 Gm.), are administered every half-hour until 1 to 3 grains (0.06 to 0.18 Gm.) have been taken. Most or all of the mercury thus ingested becomes operative as a cathartic in the intestinal tract, and there is no surplus to awaken toxic symptoms later on.

Given in one large dose, calomel produces a cathartic effect with little constitutional disturbance. One-grain (0.06 Gm.) doses given at regular intervals of an hour for eight hours produce catharsis, plus some extra intestinal irritation, and plus a general constitutional influence. When the drug is given in doses of $\frac{1}{10}$ grain (0.006 Gm.) two or three times a day, a general glandular stimulation is induced, without special intestinal disturbance. H. B. Hemenway (Jour. Amer. Med. Assoc., Mar. 19, 1910).

Better results are obtained when calomel is allowed to complete a purgative action itself than where another purgative is given. There is less liability of secondary stasis immediately following such purgation, and the bowel discharges remain normal for some time there-

after. G. L. Servoss (Oklahoma Med. News-Jour., Sept., 1910).

Large doses of calomel have been recommended by some in the early stages of **acute febrile disease, pleurisy, pneumonia, yellow fever**, and even in such affections as **cholera**. It seems possible, from relatively recent experimentation, that calomel in moderate doses may have the power to activate the processes of immunity.

In **jaundice**, or "**biliousness**" due to **exposure to cold**, calomel is also employed with asserted benefit.

In children very small doses of calomel are of great value when general **inertia** is **associated with a heavy breath and (usually) ill-smelling stools**. Four doses of $\frac{1}{25}$ grain (0.0025 Gm.) each every half-hour, repeated in four or five days if needed, sometimes change the entire aspect of the child. The drug is best administered thoroughly mixed with a little sugar, the powder being merely placed on the tongue. The tonic action of the remedy plays an important rôle here, provided only minute doses are given.

In **infantile diarrhea** this treatment is decidedly valuable; $\frac{1}{20}$ grain (0.003 Gm.) of the drug should be administered every three hours.

As an **anthelmintic** calomel may also be used with advantage.

All the mercurial preparations possess **diuretic** properties, but these are especially marked when calomel is employed. The increase of urine may range from a few ounces to as much as 370 ounces (Jendrassik). When calomel is administered in moderate doses, repeated every three or four hours, the diuretic action appears early in some cases and only after four or five days in others. Ac-

cording to Lipari, tolerance for calomel is greatest where the diuretic action is most rapidly produced, while it is least where the diuresis is retarded. The main untoward feature in its use is the marked tendency to cause ptyalism and other manifestations of mercurial intoxication. Hence the patients should be carefully watched. Calomel is especially efficacious in **edema of cardiac origin**. Six doses of $1\frac{1}{2}$ grains (0.1 Gm.) each may be given during the day, one every three hours. After the first few doses have been given, as a rule, an increase in diuresis is established, and on the second or third day copious evacuations of the bowels take place. There is marked improvement in all the symptoms, cardiac and other. Even after the calomel has been discontinued these good results persist for from twenty-four to forty-eight hours.

In order to prevent excessive salivation, or to relieve it when already produced, the following mouth-wash may be used:—

R Potassii chloratis ... ʒiiss (10 Gm.).
Acidi tannici gr. iv (0.25 Gm.).
Aque destillate fʒx (300 c.c.).

M.

The calomel does good by relieving the congestion of the liver and the renal circulation, thus indirectly reducing the resistance to the heart. At the same time an absolute milk diet should be ordered. Of 107 cases of grave **cardiac disease** with distressing symptoms of failure of the heart treated in this manner by Moraldescu there were 14 deaths: 2 died of pneumonia after the heart symptoms had been relieved; 3 died before the treatment had sufficient opportunity to be tried, and the remaining 9 were of ad-

vanced years and the disease also was far advanced.

Mercury is especially of value when there is no concomitant renal or hepatic disorder, and is harmful, according to Huchard, when the urine contains albumin. Pathological changes in the kidneys, indeed, prevent or abridge its action.

According to Landau, calomel is appropriate in severe **dropsy** not only when due to **valvular disease**, but also when due to cardiac failure from **fatty degeneration, atheroma, and myocarditis**. In **fatty heart** he considers it in some ways a specific, as it not only causes profuse diuresis, but causes the absorption of fat. He advises that it be given for six to eight days in about 1-grain (0.06 Gm.) doses five times in twenty-four hours, at intervals of three to four hours. Profuse diuresis sets in, as a rule, on the fifth day. The calomel should be still continued until the dropsy quite disappears. On the sixth or seventh day, when diuresis is fully established, infusion of digitalis may be prescribed with additional benefit. If the dropsy has not disappeared after the first course, the treatment may be repeated after an interval of a week. Mild stomatitis, gingivitis, colic, bloody stools, hoarseness, etc., need not interrupt the calomel treatment. Should, however, diarrhea be severe, the dose may be reduced to 3 or 4 powders a day (Landau).

Calomel has also been used as a **diuretic in renal and hepatic disorders**, but the results are less constantly favorable. Its behavior in the treatment of cardiac disorders would tend to demonstrate that renal lesions inhibit calomel diuresis; hence the propriety of prescribing calomel in these

cases seems doubtful. Yet in a certain proportion of instances of **nephritis** calomel undoubtedly proves superior in action to all other diuretics, and many observers hold that the drug does not aggravate the nephritis, whether its administration is followed by diuresis or not.

In **hepatic cirrhosis** with **ascites** calomel can be given in moderate doses with safety. Zakharine has recommended its use both in **cholelithiasis**, **catarrhal jaundice**, and **hypertrophic cirrhosis of the liver**—where the usual measures have failed—in doses of 1 grain (0.06 Gm.) every hour for five consecutive hours, after which, in cirrhosis, it is further administered every two hours until pain has disappeared.

Reference made to the benefit derived from the occasional use of mercurial preparations in the treatment of **chronic valvular diseases of the heart** where failure of compensation is threatening. W. Carter (*Lancet*, Apr. 20, 1907).

Calomel recommended to increase elimination in **pregnancy**. This action is best obtained by giving $\frac{1}{10}$ to $\frac{1}{40}$ grain (0.003 to 0.006 Gm.) three times a day, which course can be safely continued throughout pregnancy by omitting it for three or four days every two weeks. It should be well triturated with sodium bicarbonate, which increases its action and lessens the danger of salivation.

For twelve years the writer has made this a routine treatment in all pregnant cases where elimination was deficient, as indicated by headache, slight disturbance of the digestion, and diminution of solids and urea excreted in the urine.

Usually in less than a week after beginning this treatment the symptoms enumerated above will disappear, and the urea and solids become normal. The patient is then instructed to discontinue the pow-

ders or tablets until she again feels the need of them.

Calomel should not be employed in large doses as a purgative during pregnancy. Stricker Coles (*Therap. Gaz.*, Aug. 15, 1910).

The domain of calomel as a diuretic in pediatric practice lies entirely in **cardiac dropsy**. Several cases of cardiac dropsy cited in which digitalis, strophanthus, and caffeine had no appreciable effect on the dropsy, but when calomel was administered for its diuretic effect it brought up the urine output invariably from 200 c.c. to 2000 c.c., and even up to 4800 c.c. By using calomel in this way the author has prolonged life at least a year in hopeless cases. There were no bad effects in the way of mercurialization. F. v. Szontagh (*Archiv f. Kinderheilk.*, Bd. lv, S. 121, 1910).

Excellent results are obtained from calomel where a diuretic effect is desired in the presence of **syphilis**, as in mesoaortitis luetica with edema, luetic liver disease with portal stasis, and luetic renal disease with general edema. In ascites with portal stasis results can be expected only if the stasis is due to a syphilitic lesion or if collateral circulation has been established naturally or artificially. Calomel is contraindicated in the presence of idiosyncrasy, peritonitis, intestinal obstruction, and parenchymatous nephritis. To test the tolerance, not more than 2 doses of 3 grains (0.2 Gm.) each, with $\frac{1}{12}$ grain (0.005 Gm.) of extract of opium, should be given on the first day, to be increased on the following days, until 4 to 6 doses are given. The dose should then be diminished for two to three days so that the entire amount taken is 45 to 75 grains (3 to 5 Gm.). Calomel is not a pure renal diuretic, but directs fluid from the intestines into the blood. Fleckseder (*Wien. klin. Woch.*, Nu. 41, 1911).

In **lupus**, especially in an old, ulcerated, turgescient form, with deep infiltration, Asselbergs has found in-

jections of $\frac{3}{4}$ grain (0.05 Gm.) of calomel (into the buttocks) of decided, though not always lasting, value. In the more superficial forms, and in lupus erythematosus benefit was less clearly apparent.

Calomel has been used **locally** as a stimulant in chronic inflammatory and ulcerative processes of the skin and mucous membranes, but its possible toxic effects impose caution in this direction. In **syphilitic ulcers** it may be used as a dusting powder. When it is used in **phlyctenular conjunctivitis**, potassium iodide should not be given simultaneously, as a highly irritating compound would otherwise be formed with the portion of the iodide eliminated with the lachrymal secretion.

Mercuric chloride, or *corrosive sublimate*, aside from its uses as an antiseptic (see WOUNDS), and in **syphilis** (see SYPHILIS), is possessed of useful applications very similar to those of calomel, doses commensurate with its greater strength being, of course, employed. Here, again, the activity of mercury as a tonic becomes manifest, provided very small doses are adhered to.

Injectations of salicylate of mercury, thymolacetate of mercury, and oleum cinereum are not influenced by the coincident presence of potassium iodide in the tissues. Hence the author recommends the salts mentioned in using mercury with iodine. F. Lesser (Deut. med. Woch., Nov. 28, 1901).

In the **summer diarrhea** of children and adults very small doses of mercuric chloride are especially effective— $\frac{1}{100}$ grain (0.0006 Gm.), repeated every hour or two. The drug stimulates the intestinal tract, acts as a germicide, thus arresting putrefaction,

and rids the bowel of its contents by gentle catharsis.

In **dysentery** enemata of mercury bichloride were successfully employed by Lemoine and others in cases where ipecacuanha had failed, and where the patients complained from the beginning of nausea and vomiting. A 1:5000 or 1:6000 solution of the bichloride was used, and enemata of 6 fluidounces (200 c.c.) each given once to three times daily. A large proportion of the cases were cured. Calomel was sometimes given, also, by the mouth.

The drug has also been recommended in the treatment of **diphtheria**, $\frac{1}{100}$ grain (0.0006 Gm.) being given every three hours; but antitoxin is, of course, a far more effective agent.

On the whole, the internal administration of mercury bichloride in affections other than syphilitic has not received much support from the profession, owing to the fear of causing salivation and other manifestations of mercurial poisoning. Calomel has usually been employed, though, in truth, this agent is more liable to give rise to toxic symptoms than the bichloride.

Subcutaneous injections of the bichloride have been recommended in a variety of affections. Thus, Jullien lauds treatment of this kind in **gonorrheal rheumatism**. Consalvi and Smith have reported good results in **cerebrospinal meningitis** from injections of $\frac{1}{15}$ to $\frac{1}{4}$ grain (0.004 to 0.015 Gm.). Smith gave the larger dose at first, and then $\frac{1}{15}$ grain every hour until symptoms of gastrointestinal irritation appeared. In **pernicious anemia** De Francesco and Patera also claim benefit from repeated injections of the drug.

Research on rabbits demonstrating that intravenous injection of corrosive sublimate has an unmistakable, though moderate, action in arresting or retarding an **infectious process** in the depths of the **eye** in the large majority of cases, both acute and chronic. Tumminia (Gaz. degli Ospedali, xxv, No. 109, 1904).

The author highly recommends the use of bichloride of mercury in infectious and contagious diseases. For many years he has used it with good results in **scarlet fever, measles, pertussis, la grippe, pneumonia, and typhoid fever**, provided they came under care early, before complications or profound toxemia had developed, without a complication or death. He has also treated **intestinal diseases in children** with bichloride, without a single death in cases that came early.

The dose is $\frac{1}{16}$ to $\frac{1}{8}$ grain (0.004 to 0.008 Gm.) every two or three hours for an adult; for children, in proportion, except in severe syphilis. He administers $\frac{1}{16}$ to $\frac{1}{8}$ grain (0.004 to 0.008 Gm.) hypodermically once a day for four days, and then twice a week for three weeks, and also gives during the hypodermic medication $\frac{1}{16}$ to $\frac{1}{8}$ grain by mouth, five or six times daily, continuing the drug for several months, or longer, if necessary.

As soon as the gums swell and the teeth become slightly tender, one should stop the drug for a few days, resuming it as soon as tenderness and swelling have disappeared. H. E. Jones (Va. Med. Semi-Monthly, Jan. 22, 1909).

Intravenous use of bichloride of mercury recommended in a variety of conditions, especially the not infrequent cases of **septicemia** in which the micro-organism responsible remains obscure.

Even where the infection was so severe that the patient's condition seemed hopeless, the writer has obtained almost miraculous results. He employed the following formula:—

R Hydrargyri chlo-

ridi corrosivi... gr. $\frac{1}{16}$ (0.01 Gm.).

Sodii chloridi ... gr. $\frac{1}{4}$ (0.075 Gm.).

Aquæ sterilisatæ. f3iiss (10 c.c.).

M.

This is slowly injected into a vein. The temperature usually falls promptly and the patient's general condition improves. The same dose may be injected three times in twenty-four hours. Baccelli (Il Polichnico, No. 13, 1911).

The writer administered $\frac{1}{32}$ grain (0.002 Gm.) of mercury bichloride three times a day to the **mothers of nursing syphilitic babies**, and found that its effect upon the specific process was slight though positive. He then administered the same dose to over 200 cases of non-infected nursing mothers whose infants had vomiting, diarrhea, colic, lack of gain in weight, constipation, or skin manifestations. Between 30 and 40 per cent. of these cases were benefited. No harm resulted in the cases not improved. Any nurslings not prospering were considered good subjects. The effect upon the non-infected mother was sometimes that of a general tonic, but in most cases no effect was observed. In a number of instances where nursing had been discontinued it was possible to re-establish the function after twelve weeks. The infant's weight increased rapidly in many cases where it had been stationary. **Vomiting** of whatever cause stopped within twenty-four hours, unless due to organic obstruction or overfeeding. In **diarrhea** the movements became less numerous, and undigested green, curdy, mucous, foul-smelling stools were replaced by normal ones. **Constipation** in a number of cases was relieved very promptly. **Colic** was benefited more regularly than any other symptom with the exception of gain in weight. **Eczema** in a few cases was improved at once. **Urticaria** seemed also to have been benefited. It was rarely necessary to continue the use of the drug for

more than four weeks, although in a few cases it was continued for months. How the beneficial effect is obtained cannot be positively stated. Haas (Archives of Pediat., July, 1912).

The external uses of mercury bichloride are very numerous. In the treatment of **furunculosis** or **boils** it is extremely valuable, and often succeeds in arresting them when used early. Compresses of a 1:500 solution applied over the spot—or, when the furuncle shows its first signs on an extremity, baths of this strength—are very efficient. The threatened region should be kept moist with the solution.

In **onychia maligna**, **glanders**, and **anthrax** these applications are also of value. The effect is enhanced by using warm solutions. The salt is also used with advantage in many skin disturbances, including those attending infectious fevers. In **small-pox** it is distinctly effective in the prevention of pitting. Talamon for this purpose proceeds as follows: On the first or second day of the eruption, the face is washed with soap and water, rinsed with borated water, and wiped dry with absorbent cotton. After the third day the washing is unnecessary. The eyes are protected with borated wadding, and a solution of mercury bichloride applied with an atomizer. The spray is applied chiefly to incipient pustules. Fifteen minutes after this operation of atomizing, which should not last more than a minute, the face is rubbed with a pledget of wadding dipped in a glycerin solution of sublimate of the strength of $\frac{1}{2}$ dram (2 Gm.) to the fluidounce (30 c.c.). The procedure is repeated three or four times a day in the first three days,

and then twice until the sixth or seventh day, when the spray is suspended and the glycerin painting continued until the scabs begin to drop off. The results are highly successful except in cases of confluent small-pox. The spray solution is made up as follows:—

R. Corrosive sublimate,
Citric acid...of each gr. xv (1 Gm.).
Alcohol m℥xxv (5 c.c.).
Ether q. s. ad f℥xiiss (375 c.c.).
M. c.

Calomel employed as an antiseptic in 4000 to 5000 confinements, with very satisfactory results. The agent owes its safety to its insolubility, while its antiseptic property appears to depend on the production of coagulation of proteins when brought into close contact with them. Experiments with pathogenic bacteria have shown that its antiseptic value is quite high, and that when applied to a given surface it is perfectly capable of preventing infection by small amounts of bacteria. As ordinarily used there appears to be no danger of causing intoxication, and the author warmly commends it as a dusting powder to be applied to the hands after these have been sterilized in the usual way before performing obstetric manipulations. Theopold (Deut. med. Woch., Feb. 14, 1907).

In sterilization of the skin by a spirituous solution of mercury perchloride before operation, the writer paints on a 1:500 solution of chloride of mercury in methyl alcohol twice at an interval of ten minutes. He tried this method in 102 cases and in all aseptic cases obtained primary union. The method is of advantage over the iodine method in that it causes no skin irritation. Colin Clark (Brit. Med. Jour., Sept. 28, 1912).

Solutions of mercury bichloride in distilled water are far more permanent than those in tap water, decomposition at once setting in in the latter

and being kept up through the influence of air and light. Sodium or ammonium chloride hastens the solution of the mercury salt in water, but their presence distinctly impairs the antiseptic power of the bichloride, the dissociation of which into ions, as well as the precipitation of proteins by the bichloride, is hindered.

Cyanides of Mercury.—The oxycyanide of mercury has been highly lauded as an antiseptic in surgery. It is well tolerated by the tissue, and is considered especially applicable to suppurating surfaces or mucous membranes, *e.g.*, the conjunctiva, to render them aseptic.

As a disinfectant for metallic instruments, oxycyanide of mercury is advantageous in that it does not in any way affect the latter, not even the edge of cutting instruments. A 3 per cent. solution corresponds in power to a 2 per cent. solution of corrosive sublimate, but a 1:10,000 solution has been found efficacious for external uses. Monod and Malgaigne found it to possess all the qualities of the bichloride. The drug being exceedingly toxic, they never use large quantities at a time and avoid using it for washing out cavities.

Chibret administered injections of a 1 per cent. solution of the oxycyanide in over 1000 cases of **syphilis**, without untoward effects in any instance. Galezowski recommends the following formula for routine use in the treatment of **choroidal atrophy** in cases of **myopia** and of **disseminated choroiditis** in **gouty persons**:—

R Cocaine hydro-

chloride gr. iv (0.25 Gm.).

Mercury cyanide gr. ivss (0.3 Gm.).

Cherry-laurel water . f3vj (25 c.c.).

Distilled water f3viij (250 c.c.).

M.

The same solution may be used for subconjunctival injection in certain cases of severe **exudative** and **plastic choroiditis**.

The cyanide of mercury is highly recommended as an antiseptic for use by oculists, and is non-irritating.

It has been recommended as a safe agent for hypodermic use. According to Harrington's experiments, mercury cyanide is not to be relied on as a general surgical disinfectant.

Intramuscular injections of mercury advocated not only for **syphilitic ocular affections**, but also for certain non-syphilitic ones, such as **optic neuritis**, **suppurative infectious processes**, **sympathetic ophthalmia**, and certain forms of **detachment of the retina**, especially when accompanied by evidences of choroiditis. Schmidt-Rimpler (*Deut. med. Woch.*, Bd. xxxii, Nu. 1, 1906).

Report of 26* cases of **tuberculosis** and other diseases of vegetable parasitic origin treated by deep muscular injections of mercuric succinimide. The most efficient dose is such as will just fall short of mercurialization, *viz.*, 1½ grains (0.91 Gm.). The cases treated included 1 of **bronchopneumonia**, 3 of **typhoid fever**, 5 of **epidemic catarrh**, 10 of **tonsillitis**, 1 of **cystitis**, 1 of **chronic otitis media**, 1 of **cellulitis**, 4 of **furunculosis**, 1 of **chancroid**. The earlier in **typhoid fever** the remedy is injected, the better the results. B. L. Wright (*Med. Record*, Dec. 2, 1911).

The author treated **pernicious vomiting of pregnancy** with hypodermic injections of mercury. The drug kept the bowels moving briskly for several days and had a marked sedative effect on the stomach.

He treated a case of **hepatic engorgement** and persistent **vomiting** following a **drunken debauch** in the same way, with excellent results. Of several cases thus treated, the symptoms of gastric irritation were promptly relieved in all. In a case

of **puerperal eclampsia** he found mercury of benefit. The patient, unconscious, was given $1\frac{1}{2}$ grains (0.1 Gm.) of mercury salicylate, which not only opened the bowels thoroughly, but put the kidneys actively to work. In another case in which the patient was in a comatose condition from **chronic nephritis** the drug was also used with decidedly good results. Mercury thus used in proper dosage almost invariably gives this purgative effect, which lasts for several days. A 10 per cent. solution of the mercury salicylate in oil was used. F. M. Perrow (Va. Med. Semi-Mthly., May 24, 1912).

Frequently repeated bathing of the eye with a 1:2000 solution of mercury cyanide for three days preceding **cataract operations** eliminates all possibility of suppuration in the organ: 1. By killing all micro-organisms on the conjunctiva. 2. By causing the formation in the interior of the eye of antitoxic bodies. Subconjunctival injections of the same solution constitute the most effective measure available to arrest or cure cases of **chronic iritis** or **iridochoroiditis** and, in particular, cases of **atrophic chorioretinitis**, for which hitherto no good remedy has been at hand. E. Grand-Clément (Lyon Méd., July 21, 1912).

Subconjunctival injections of cyanide of mercury employed in numerous cases of **trachomatous keratitis**, **acute indolent ulcers**, **ulcer hypopyon**, **recent corneal opacities**, **parenchymatous keratitis**, and **episcleritis** and **scleritis**. Besides these a large number of mixed cases of "irritable eyes" were similarly treated: Patients with scarred corneas, diseased lids, more or less ciliary injection, blepharospasm, and lachrymation. The treatment consisted of subconjunctival injection of 10 to 20 minims (0.6 to 1.25 c.c.) of a 1:4000 solution of mercury cyanide in sterile water. Within an hour or so all discomfort disappeared. The results were very satisfactory. **Blepharospasm** and **lachrymation** were promptly relieved.

Pain in **scleritis** and **ulcers** ceased. Recent corneal opacities were improved. As a routine for **chronic trachomas** with **pannus**, if time and suffering are of moment, cyanide injections hold high place. C. B. Meding (Ophthalmology, July, 1913).

From 12 years' experience the writer concludes that mercury salicyl-arsenate is more valuable than other soluble salts of mercury or arsenic in various complex ocular affections in which syphilis, generally congenital, is associated with dystrophic and chronic inflammatory processes, in particular tuberculosis in an attenuated form. In a 3 per cent. solution, put up in ampoules, the preparation is also known as enesol. Used freely twice a day for bathing the eye, the compound rapidly overcomes beginning infection of the cornea, even in the presence of hypopyon, providing dacryocystitis is not simultaneously present or is vigorously treated. When a wound of the cornea becomes yellow and is complicated by suppurative iritis, use of the compound will nearly always lead to recovery. Terson (Paris Médical, Oct. 6, 1917).

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AND

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Philadelphia.

MESCAL BUTTON. See AN-
HALONIUM LEWINII.

METHYL ALCOHOL POISONING.—All the alcohols of the mon-acid series are toxic, though in an ascending scale, from methyl alcohol to amyl. Methyl alcohol (wood alcohol, cologne spirits, Columbian spirits, colonial spirits, eagle spirits, etc.) [CH_3OH] is, however, cumulative in its effects, and the others are not. This is apparently due to the fact that methyl alcohol remains more or less unchanged when in contact with the tissues, and consequently its influence is continuous (Jelliffe). It is used as an adulterant and substitute for grain alcohol (ethyl alcohol) in cheap whisky and other alcoholic beverages, Jamaica ginger,

lemon and other cooking extracts, essences, and flavoring fluids; in the preparation of many proprietary and patent medicines, *e.g.*, witchhazel, domestic liniments, bay rum, cologne and Florida waters, and other perfumes, and in the arts, as in the manufacture of varnishes, for stiffening hats, lacquering brass, etc. It is evident that the poison may either be introduced by the mouth, be absorbed by the skin, or be inhaled, in the latter cases producing chronic poisoning by its cumulative effects, and in the first either acute or chronic poisoning, according to amount taken and the length of time the poison has been used.

SYMPTOMS.—The symptoms of **acute poisoning** are abdominal pain, general weakness, nausea, vomiting, vertigo, headache, mydriasis, and bilateral blindness. If recovery does not occur, there is a marked depression of the heart action, a sighing respiration, cold sweats, delirium, unconsciousness, coma, and death. The blindness may appear in a few hours or be delayed. It is generally complete, with subsequent improvement, and, finally, a relapse into permanent blindness.

The symptoms of **chronic poisoning** are not so pronounced or so easily recognized as those of the acute form. Hyperesthesia and paresthesia of the hands, pain induced by pressure over nerve trunks, and pain in the joints indicate a peripheral neuritis. In a few days absolute blindness usually appears, which follows the course indicated under acute poisoning.

DIAGNOSIS.—Acute abdominal distress, followed by blindness, and perhaps peripheral neuritis, should lead one to suspect this condition.

PATHOLOGY.—Methyl alcohol appears to have a selective action on the optic nerves, which suffer a destructive inflammation of their fibers or retinal elements (or both), followed by atrophy. The optic outlines are blurred, there is some papillary edema, and the central vessels are engorged. As the acute papillitis subsides vision improves somewhat, only to be followed by postneuritic atrophy and permanent blindness.

TREATMENT.—Dilution of the poison in the stomach with warm water, as well as its removal by the stomach pump and

high rectal injections, should be followed by the use of **pilocarpine**, **hot baths**, **diuretics**, and **potassium iodide** internally. **Stimulants** are indicated, especially **strychnine** and **coffee**. **Heat** should be applied to the body and to the extremities; **alternate hot and cold affusions**, however, may be employed to combat coma. A **milk diet** is commended, especially for its diuretic action. The optic nerve condition may be favorably influenced by **strychnine**.
W.

METHYL AND METHYLENE CHLORIDES.

Methyl chloride (monochloromethane; chloromethyl) [CH_3Cl] is a gaseous compound obtained by the reaction between methyl alcohol and hydrochloric acid in the presence of zinc chloride, with subsequent purification. It occurs as a colorless gas with a sweet taste and an ethereal odor, soluble in $\frac{1}{4}$ its volume of water, much more so in alcohol, and freely in ether and chloroform. It is less inflammable than ether. Under a pressure of 5 atmospheres at normal temperature it becomes a neutral liquid, which has been recommended for use as a spray to relieve pain and itching in severe **neuralgia** and **pruritus**, and to produce local anesthesia. The surface should previously be anointed with petrolatum to prevent the formation of blisters.

Methylene chloride (methylene bichloride; dichloromethane; chloromethyl) [CH_2Cl_2] is obtained by the reduction of chloroform (in alcoholic solution) by zinc and hydrochloric acid, with subsequent purification. It occurs as a heavy, colorless liquid, boiling between 104° and 105° F. (40° and 41° C.), and having an odor suggesting that of chloroform. It is soluble in alcohol and ether, and is decomposed when exposed to light and air, the change being prevented by the addition of a little alcohol.

English methylene chloride, or **methylene**, is a mixture of methylene chloride and ethyl chloride. It was recommended as an anesthetic in doses of from 1 to 4 fluidrams (4 to 16 c.c.), but is not free from danger and should not be confounded with the definite compound methylene bichloride.

A mixture of chloroform and methyl chloride (4 to 1) is also marketed as "methylene chloride."

Methylene bichloride has been proposed for use as a general anesthetic safer than chloroform. Its high cost, however, militates against its employment, and, furthermore, it is doubtful whether this compound is not even more dangerous than chloroform. One fluidram (4 c.c.) inhaled every five minutes is the average quantity required for producing anesthesia. It may be used internally in doses of from 5 to 15 minims (0.3 to 1 c.c.).

W. and S.

METHYLENE BLUE.—Methylene blue [$C_{16}H_{18}N_3SCl$] is one of the aniline dyes, a diphenylamine compound resulting from the action of hydrogen sulphide upon an oxidation product of para-amidodimethylaniline. It occurs as a fine, dark-green crystalline powder or in crystals, readily soluble in water, less readily in alcohol, the solutions having a deep-blue color. A solution of methylene blue cannot be distinguished from a solution of methyl blue or methyl violet (pyoktanin) without great care, and toxic effects have been observed as a result of errors in prescribing the one drug for the other, the dose of pyoktanin being smaller.

Tests to distinguish methylene blue from methyl blue are as follows: 1. The meniscus on the surface of a solution of methylene blue in a test-tube, or a thin film of such a solution, has a greenish color, while that of methyl blue is blue under all circumstances. 2. When sodium hydrate is added to a solution of each the color of the methylene-blue solution is changed to violet, while that of the methyl blue becomes a reddish brown (Smith). 3. A diluted solution of methyl blue becomes decolorized on the addition of ammonia water, while a solution of methylene blue (even if very highly diluted) is not decolorized.

PREPARATION AND DOSE.—*Methylthionina chloridum*, U. S. P. (methylene blue). Dose, 1 to 4 grains (0.06 to 0.25 Gm.); official average dose, $2\frac{1}{2}$ grains (0.15 Gm.).

MODES OF ADMINISTRATION.—Methylene blue, when used orally, is best

given in capsules or cachets. Nutmeg may be combined with it to prevent gastric and cystic irritation. When it is used by injection, the dose is from 1 to $1\frac{1}{2}$ grains (0.06 to 0.1 Gm.), and the solution should always be boiled before use to prevent abscess formation.

In prescribing this product, care should be taken to add the word "medicinal," or, better, the official Latin term, *methylthionina hydrochloridum*, may be used. Commercial methylene blue contains zinc, and therefore may cause vomiting.

PHYSIOLOGICAL ACTION.—Externally, methylene blue is antiseptic and analgesic.

In guinea-pigs the giving of a toxic dose of methylene blue is followed, according to Combemale, by a marked increase of the reflexes and of the respiratory rate, with subsequent motor paralysis and death. At the necropsy there is found a chocolate discoloration of the blood, caused by a destructive action upon the red blood-corpuscles, flaccidity of the heart, pulmonary atelectasis, and engorgement of the liver, with blue discoloration of the biliary ducts, and of the gastric and intestinal mucous membrane. Lauder Brunton and Delépine subsequently observed that the drug sometimes caused a great accumulation of iron in the liver.

Ehrlich and Leppmann have expressed the view that the analgesic properties of methylene blue depend upon an elective affinity for the axis cylinders of the nerve terminations.

Experiments on frogs and rabbits by Mikhaïloff have shown that the leucocytes do not fix methylene blue until a short time before death, and even then only rarely. At the autopsy of the animals experimented upon for a period of three weeks there was found in all the serous cavities a blue liquid; all the organs were also colored; the blood was methemoglobinized, the result being a loss of oxygenation, which had led to degeneration of the parenchyma and favored thrombosis.

Lemanski and Main have found that methylene blue can be detected in the saliva forty minutes after its introduction by the mouth, and in one hour and fifteen minutes after its use by the rectum.

Elsner has estimated by colorimetric methods the amount of methylene blue excreted from the body in the urine and intestines. In 4 cases the total quantity excreted averaged 68 per cent. of the quantity ingested. The remaining portion was probably either decomposed by bacteria or retained in the body, especially if there was any dead tissue near; a very low percentage of excretion was found in a case of severe gastrointestinal atony; the excretion improved as the atony was benefited.

Müller has found that in normal kidneys the remedy first appears in the urine twenty minutes after its intramuscular injection, the elimination reaching its maximum in about one and three-quarter hours, then gradually diminishing. Slight retardation was noticed in cases of interstitial nephritis, and acceleration in a case of chronic parenchymatous nephritis.

THERAPEUTICS. — Methylene blue being eliminated by the urine, Achard and Castaigne conceived the idea of using this property to determine renal permeability when disease of the kidney is suspected. To test the eliminative function of the kidney, 1 grain (0.065 Gm.) dissolved in 10 minims (0.6 c.c.) of water is injected into a muscle. If the kidneys are normal the urine should show a greenish discoloration in from fifteen to thirty minutes, and continue discolored for thirty-six hours.

In **diabetes mellitus** methylene blue appears to act somewhat like antipyrin. After its administration in full doses up to 6 grains (0.4 Gm.) three times daily for six weeks, sugar has been found to disappear from the urine.

Stucky has obtained good results from this drug in **vesical irritability** and **cystitis**, particularly in cases of enlarged prostate in the aged.

Lemoine employed methylene blue in 8 cases of **albuminuria**. In 5 there followed a rapid diminution and in 3 a complete disappearance of the albumin. The doses employed varied from $\frac{1}{8}$ to $\frac{3}{4}$ grain (0.02 to 0.05 Gm.) a day.

The property of methylene blue of staining the axis cylinders of nerves suggested to Ehrlich that it might prove useful as analgesic in painful **neuroses**,

including **neuralgia**. It was found effective at times both in this condition and for reducing the pain of **migraine**, **herpes**, **rheumatism**, and **sciatica**. Of 27 cases of **sciatica** in which Klemperer used methylene blue, in 6 cases the pains disappeared in five days. In 8 cases no effect whatever was observed. About 7 grains (0.5 Gm.) were given daily.

Combemale obtained complete relief with it in the **neuritis of alcoholism**, of **tubes** in the second period, and in **bone pains of tuberculous, syphilitic, and traumatic origin**. The drug failed to act, however, in the neuralgias of hysteria, in the lancinating pains of the cachectic period of **tubes**, and in those of acute articular rheumatism. It was usually given in doses of 3 grains (0.2 Gm.) a day. The untoward effects most commonly, although not frequently, observed were headache, nausea, and diarrhea.

Armstrong finds methylene blue particularly valuable in those forms of **rheumatoid arthritis due to autointoxication from the intestinal tract**.

Zaitzev and Torporkov found methylene blue useful in severe **psychoses accompanied by marked insomnia**, in doses varying from a fraction of a grain, given hypodermically, to 2 or 3 grains (0.13 to 0.2 Gm.) by the mouth. Hughes and Lovelace used it in 22 cases of various forms of **mania** and **paretic dementia**, in all of which wild excitement existed. In all but 6 cases it produced a calmative effect, "a natural quietude, unlike the sedative action of other drugs," coming on three or four hours after a dose was given and lasting for from fifteen to twenty-four hours. Generally 1 grain (0.06 Gm.) was given twice daily or oftener, hypodermically; in some instances double this dose in capsule. (To avoid abscesses the solution should be boiled before injection.) Bodoïn tried methylene blue in 14 cases of cerebral excitement, including **mania**, **paranoia with delirium**, **chronic alcoholism**, and **hysteroepilepsy**, and found its use very satisfactory when it was injected into the gluteal muscles in doses of from 1 to $1\frac{1}{2}$ grains (0.06 to 0.1 Gm.). Its quieting effects continued from one to four days. There were no untoward effects.

Pain and odor are frequently removed when methylene blue is injected in the dose of 1 grain (0.06 Gm.)—in aqueous solution—directly into inoperable **cancerous growths**. At times an inhibitory action on the tumor has also been observed.

In **malarial fevers** Guttman and Ehrlich, basing their opinions upon the fact that methylene blue stains the hematozoön, were led to consider this agent as of value. The remedy was also tried with apparent success by Thayer in doses averaging $1\frac{1}{2}$ grains (0.1 Gm.) five times a day. The only untoward effect produced was strangury; this was relieved, however, by the ingestion of an equal quantity of nutmeg and did not appear at all where nutmeg was given from the beginning. On the whole, though effective in malaria, methylene blue is inferior to quinine or arsenic. It is worth a trial, however, where quinine is not well borne. Stucky has reported good results from it, the plasmodia disappearing after quinine had proved ineffectual. In **malarial hematuria** it has given him better results than any other remedy. He administers it in doses of 3 grains (0.2 Gm.) three times daily until the urine becomes decidedly blue.

Baginsky tried methylene blue in 4 cases of intermittent fever in children. The patients soon showed a dislike for the remedy, which was vomited. While it can in no way replace quinine, he commends its trial where children absolutely refuse to take the former remedy.

Reichmann has advised the administration of $\frac{1}{2}$ - to $\frac{3}{4}$ - grain (0.03 to 0.05 Gm.) doses of methylene blue in inflammatory disorders of the liver, such as **cholangitis** and **cholecystitis**. Bauer has detected considerable amounts of the drug in the bile.

In **gonococcal urethritis** methylene blue seems to have proved of value when used internally and locally, doubtless through its antiseptic action. Moore suggests its use in doses of 3 grains (0.2 Gm.) three times a day, together with 15 grains (1 Gm.) of potassium citrate.

O'Neil asserts that methylene blue will cure gonorrhea in from four to seven days, being a drug especially fatal to diplococci and pyogenic bacteria. He

advises that it be given in gelatin capsules in 1-grain (0.06 Gm.) doses, combined with 1 drop of nutmeg oil and 2 drops of sandal oil, three or four times a day. After the fourth day the dose may be administered twice a day.

According to Chaleux and others, methylene blue in concentrated solution, or powder, is useful in the treatment of **metritis**, being painless and non-toxic. It quickly arrests **metrorrhagia** and **menorrhagia** and diminishes **leucorrhœal** discharges. It sometimes removes pain in **dysmenorrhea**, accompanied by changes in the uterine mucosa.

The local use of methylene blue in **Oriental sore** has been advised by Billet. For **Vincent's angina**, the following is recommended:—

R. *Methylthionine hydrochloridi* gr. xlv (3 Gm.).
Glycerini,
Alcoholis ãã gr. lxxv (5 c.c.).

M. Sig.: To be painted over the membrane-covered areas.

W. and S.

MIDDLE EAR, DISEASES OF.

—The four generally recognized divisions of middle-ear disease are *acute catarrhal otitis media*, *acute suppurative otitis media*, *chronic suppurative otitis media*, and *chronic catarrhal otitis media*. An exact scientific classification of these diseases is impossible, for the reason that every degree or stage, from the simplest catarrh to the severest form of inflammation, may occur successively in the same attack. A mild catarrh may rapidly become a severe inflammation or suppuration, whereas the acute inflammatory state may abate and subsequently assume the simple catarrhal form. It is impossible to state definitely where an acute catarrhal process ends and the acute suppurative lesion begins.

The term "catarrh" obviously can be used only in connection with an abnormal state of a mucous mem-

brane, such as the lining membrane of the middle ear, and never in a similar condition of skin surface, such as that covering the external auditory canal. Middle-ear or tympanic catarrh indicates a mild, simple inflammation of its mucosa, without serious involvement of the underlying structures and little or no systemic disturbance, but showing a pronounced tendency to resist treatment. An acute suppurative inflammation of the same cavity represents the more violent, and in some instances virulent, forms of pathological changes of the mucous membrane, resulting frequently in destruction of the mucosal lining, thus exposing the osseous structure to the ravages of the pathogenic organisms found in the consequent mucopurulent or purulent discharge. It is usually accompanied by systemic disturbance. Under prompt and proper care, this disease usually ends in recovery, without any special predisposition to relapse, but without such care it is the most dangerous of aural affections. Its importance can be forcibly brought out by the further statement that practically all serious ear affections and their complications, such as diseases of the mastoid process, sinus thrombosis, meningitis, labyrinthitis, and brain abscess, originate in an inflammatory process within the tympanic cavity. Not too much stress, therefore, can be laid on the necessity of *prompt* treatment in the initial stage of this seemingly simple aural disease, in view of the dangerous complications to which neglect or procrastination may give rise.

The etiology of the catarrhal and suppurative forms of otitis media is identical; the symptoms, both object-

ive and subjective, are similar, varying only in degree, up to the point of perforation. Before perforation the condition is regarded as catarrhal; afterwards, suppurative, and in the absence of proper care at this stage the disease assumes the character of an acute or chronic suppurative otitis media, with all its potential dangers. Inflammatory aural conditions complicating the exanthemata, influenza, pneumonia, and typhoid fever present early symptoms of such severity that they are considered purulent from the beginning, and in such cases an early incision of the membrana tympani for evacuation of the pus is most necessary.

To summarize: Catarrhal and suppurative otitis media present practically the same picture at onset. If the symptoms, however severe, yield without perforation or incision of the membrana tympani, the case may be regarded as catarrhal in nature; but if the destructive activity of the infection causes necrosis and maceration of the tympanic mucosa, with consequent perforation and discharge, then there exists a purulent inflammation, *i.e.*, an acute suppurative otitis media.

A brief survey of the more important anatomical points will give a better understanding of the pathological changes occurring in aural disease. The mucosa covering the nasopharynx acts also as a mucous lining for the Eustachian tube and middle-ear cavity, and, being greatly modified, forms the internal layer of the membrana tympani. It likewise covers the ossicles, and, finally, serves as the protective covering of the mastoid antrum and cells. Because of this intimate mucosal relationship,

it will readily be appreciated how easily, by continuity, an inflammatory process of the throat or nasopharynx can involve the middle ear and adjacent structures by way of the Eustachian tube. The same is true, in a less degree, of the external auditory canal, with the exception that this is covered with a skin reflected from the auricle, which eventually forms the external layer of the membrana tympani. The notably thin bony framework of the middle-ear cavity is surrounded by some of the most vital structures in the human economy. The roof of this cavity, always thin, is in some instances entirely absent, particularly in young children and infants. The carotid canal, through which passes the carotid artery, forms the anterior wall; the jugular fossa, in which lies the bulb of the jugular vein, constitutes the floor, while the roof is formed by the floor of the middle fossa of the skull, on which rests the temporosphenoidal lobe of the cerebellum. Above and behind the oval window, on the internal wall, is situated the Fallopian canal, which contains the tympanic branch of the facial nerve. The bony wall separating the lateral sinus from the mastoid cells is also thin to the point of translucency.

The foregoing facts make it apparent with what facility the meninges may be implicated through the roof, or the jugular vein through a dehiscence or carious erosion of the floor. The labyrinth, or nervous part of the organ of hearing, may likewise be involved by erosion through the internal tympanic wall. It should be noted also how easily Bell's palsy may be caused by injury to or disease

of the tympanic branch of the facial nerve, as may likewise a greater or less disturbance of the equilibrium should the middle-ear disease extend to the semicircular canals.

While the tympanic cavity and the mastoid antrum and lower cells are spoken of as distinct and separate cavities, the latter are, in reality, accessory to the former, being separated from it by a comparatively narrow space. Herein is afforded an explanation of the usual involvement of the mastoid process, to a greater or less extent, in practically all acute inflammatory disease of the middle ear.

Otitis media in infants deserves special mention from the fact that the petrosquamous suture provides free communication between the lymphatics and blood-vessels of the tympanic cavity and the interior of the skull. On account of this relationship, children frequently develop an otitic meningitis or other intracranial complication without even giving evidence that an aural lesion is present. Many cases of this type have come under my care, the underlying cause of the meningitis never having been suspected until, by accident or the appearance of a discharge from the external auditory canal, the real cause of the infant's illness was discovered. In proof of this one need only mention that Ponfick, in post-mortem examinations of 100 cases in which the ear was not suspected in life, found otitis media in 90 per cent. of infants under 3 years of age.

ACUTE CATARRHAL OTITIS MEDIA (*Otitis Media Acuta Catarrhalis*).

DEFINITION.—An acute non-suppurative inflammation of the middle ear.

SYMPTOMS.—In the more simple forms of infection the patient experiences only a fullness or dullness within the ear and a slight impairment of hearing. In the exaggerated type the pain is more or less severe and the loss of hearing becomes much more marked. The latter symptom is especially prominent at night. Indeed, the patient may be relatively free from all symptoms during the day, but suffer greatly from nocturnal pain. The above symptoms characterize what is termed "earache in children," to which, unfortunately, only too often little attention is paid. The pain is not confined to the ear itself, but is frequently complained of as a headache, more marked on the affected side, radiating toward the teeth, the patient especially complaining on opening the mouth and when pressure is made on the tragus. A rise of temperature is usually a matter of considerable importance, particularly in children. In some instances, however, even when the involvement is serious, the patient has very little fever, or, indeed, little, if any, inconvenience. The symptoms are so mild and seemingly unimportant, in some cases, that they do not attract attention; this shows the importance of an aural examination when the exact cause of an illness cannot be definitely determined, especially in children. Again, the temperature in children may be high, ranging from 103° to 105° F. A temperature of this height, while not usually indicating a serious complication in infants, should always be viewed with grave apprehension in an adult. In those too young to speak or otherwise indicate the location of the pain, the hand is fre-

quently raised to the ear or in the direction of the affected side. This should always make us suspicious of aural involvement in infants.

The intensity of the pain is governed by the severity of the inflammation, or, more especially, by the pressure exerted on the inflamed mucosa and drumhead by the amount of exudate or great retraction of the drumhead. This explains why the pain in acute catarrhal otitis media, with little exudate, is much less severe than that in acute suppurative otitis media, with a copious exudate.

Tinnitus aurium, which is present in most cases, causes distress to the patient when severe, and especially when it is pulsating in character. The tinnitus may resemble any form of noise, but is usually of the rushing, singing, or hissing type. That resembling the escape of steam seems to be particularly annoying.

The degree of deafness is governed almost entirely by the site of the exudate. The tympanic cavity may be well filled with fluid and yet the hearing remain fairly good, but if the exudate clogs both the round and oval windows the deafness may be very great. Hallucinations of hearing are not infrequent.

Repeated attacks of catarrhal otitis media (subacute catarrhal otitis media) in early life result in changes in the membrana tympani, as well as adhesions, which in later life are the cause of more or less deafness. This illustrates the importance of prompt treatment in all such cases, that there may be fewer instances of chronic deafness in future generations.

The duration of the disease varies from two to ten or twelve days. In mild cases the membrana tympani is

congested, more especially in the superior part, the process also extending along the long handle of the malleus. In the severer types the entire drumhead is red and swollen, owing to infiltration of the dermal layer. The landmarks (the long handle and the short process) are more or less obliterated, the former being obscured first. When bulging is present, it usually appears first in the superior and posterior quadrant or the posterior and inferior quadrant. As resolution begins, the congestion slowly disappears, Shrapnell's membrane and the long handle of the malleus being the last to recover.

As the secretion incident to the nasopharyngeal disease increases, there is a correspondingly increased full or stuffy feeling in the ear. This is caused by the pharyngeal end of the Eustachian tube becoming involved and finally blocked by the secretion,—nature's method of sealing off the communication between the nasopharynx and the middle ear, the entrance of infectious micro-organisms being thereby prevented. This stuffy feeling, therefore, should be borne for two or three days and no special attempt made for its relief; if the protective barrier is broken through by either blowing the nose or the use of Politzer's method of inflation, the chances of inducing an infective otitis media are very great. This illustrates forcibly the importance of never inflating an ear during the early stage of an acute inflammatory disease.

ETIOLOGY.—The most common cause of middle-ear catarrh is an extension, by continuity, of a similar process from the nasopharynx through the Eustachian tube into the middle ear.

This catarrhal condition is usually greatly aggravated by the presence of diseased tonsils and adenoid vegetations in children and by nasal obstruction in adults. The immediate cause in the usual case, therefore, is what is ordinarily termed a "cold in the head," or acute coryza, regardless of what the underlying etiological factor may be. Additional exciting causes are the unwise and dangerous practice of the use of the nasal douche and the snuffing up of various solutions; also sea-bathing and dentition in children. As blowing the nose during an attack of coryza is one of the chief causes of middle-ear infection, it should be rigorously avoided, especially when both nostrils are closed, as in the usual method of clearing the nose; in other words, one nostril should always remain open during this procedure.

The diseases which not only cause a catarrhal inflammation of the middle ear, but one apt to become rapidly suppurative, and indeed credited with being suppurative from its inception at times, are measles, scarlatina, diphtheria, pneumonia, typhoid fever, and influenza. The first- and last-named affections are probably productive of more serious aural disturbance than all other diseases combined. This is especially true of influenza, as is shown by the fact that before its advent tympanic and mastoid inflammation requiring operative intervention were comparatively rare, whereas at present these are among our most common diseases. Whooping-cough, bronchitis, and parotitis, as well as inflammation conveyed by means of the lymphatics and general circulation, are additional causative factors in middle-ear disease.

PATHOLOGY.—The mucosa becomes hyperemic and more or less swollen, according to the severity of the inflammatory process. The amount of the accompanying secretion is likewise governed by the degree of inflammation. When the entire mucous membrane is involved, the secretion is abundant, and when it is serous in character the condition is known as *serous catarrh*. When the inflammation and consequent

pressure exerted from without. Cases of this type are sometimes more painful than the acute suppurative form.

PROGNOSIS.—In the less severe cases the prognosis is always good when treatment is prompt. In the severer types, especially those complicating the exanthemata, pneumonia, and typhoid fever, the prognosis, although favorable, should be more guarded.

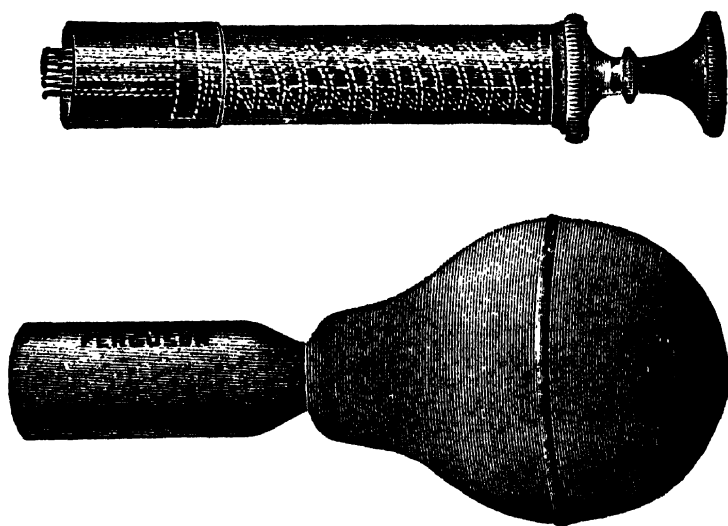


Fig. 1.—Artificial leech.

secretion are confined to the pharyngeal end of the tube, without involvement of the middle-ear cavity, the condition is known as *tubal catarrh*. *Hydrops ex vacuo*, or a collection of practically non-inflammatory fluid in the middle ear, is the result of a slowly developing tubal catarrh, with extension into and final involvement of the tympanic cavity. If the Eustachian tube remains blocked on account of the swelling of its mucous membrane, the middle ear becomes a closed cavity. The subsequent absorption of the air within results in great retraction of the membrana tympani, owing to the atmospheric

TREATMENT.—So far as possible, one should remove the cause, such as diseased tonsils and adenoids, nasopharyngeal catarrh, and nasal obstruction of any type that may interfere with free nasal respiration. The patient should be confined to bed, or at least to an equable temperature, and placed on a restricted diet. The bowels should be freely opened, and small, frequently repeated doses of tincture of aconite administered. In the early or hyperemic stage blood-letting by means of the natural or artificial leech (Fig. 1), preferably the latter, in front of the tragus is of distinct benefit. At the inception of

the disease, the instillation of, or irrigation by, warm solutions will frequently abate an attack of acute catarrhal otitis media. For this purpose a **normal salt solution** or saturated **boric acid solution** may be used. In the very mild cases the aural pain will be promptly relieved by instilling hot boric acid solution into the ear and allowing it to remain for about five minutes, a piece of hot flannel being placed over the ear to retain the heat. Equal parts of **tincture of opium** and **tincture of belladonna**, or a 5 to 10 per cent. solution of **phenol** in glycerin, properly heated, will answer a similar purpose; this is to be repeated, if necessary, 3 or 4 times a day. A 5 to 10 per cent. solution of **cocaine** is credited with being of benefit in some cases.

Since our chief object in treatment is to restore the patency of the Eustachian tube and rid the tympanic cavity of secretion, it is necessary to employ **inflation by means of Politzer's method** (Fig. 2) as early as possible. This should never be done, however, until the acute inflammatory symptoms have subsided, which, in the average case, will be in two or three days after the last vestige of pain has passed. Force should never be used in inflating the ear, and this is avoided by placing a few drops of chloroform in the bag. If inflation does not cause pain, it should be repeated every two or three days until the hearing has been restored. It is important to remember that *force should never be used*.

If the disease subsides under the above treatment, even though considerable fluid may have accumulated in the tympanic cavity, it is still regarded as a catarrhal otitis media.

If, however, it is necessary, on account of the accumulation of fluid, to incise the drumhead, or if the membrana tympani has ruptured spontaneously, the case is then known as an acute suppurative otitis media, the treatment of which will be taken up under that heading.

ACUTE SUPPURATIVE OTITIS MEDIA (Otitis Media Acuta Purulenta).

DEFINITION.—An acute suppurative inflammation of the middle ear.

SYMPTOMS.—The earlier symptoms are those of an acute catarrhal

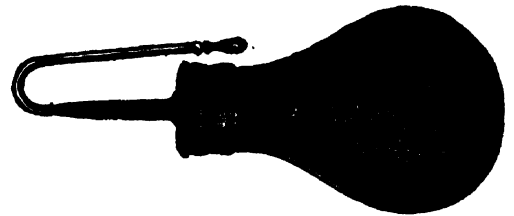


Fig. 2.—Poltzer bag.

otitis media up to the point of perforation, in the average case. In some instances the attack seems to be suppurative from its inception. The symptoms are then greatly exaggerated, the pain being intense and continuous, and radiating over the entire side of the head. In extreme cases the suffering is so acute and the temperature so high that in conjunction with the changed mental attitude the picture resembles one of meningitis.

In all acute suppurative conditions of the middle ear the mastoid process is involved to a greater or less degree, and accordingly there is usually some tenderness about the ear and over the mastoid process. The labyrinth is also involved occasionally, as is manifested by attacks of

vertigo and tinnitus aurium. Impairment of hearing is usually well marked. As a rule, one ear is involved, but both ears frequently are affected during an attack complicating the exanthemata or influenza.

Spontaneous perforation of the membrana tympani may occur from the first to the fourth day in the more virulent forms of infection, or may not occur for ten days or two weeks in the milder cases. Usually great relief follows the evacuation of the pent-up secretion, the pain and fever subsiding simultaneously. If this improvement is not shown, however, and the symptoms above enumerated continue, there is great probability of more serious involvement. The profuse discharge lasts from one to two weeks, after which it gradually subsides, usually ceasing in the third or the fourth week.

In addition to the hyperemia and swelling of the membrana tympani, the redness is more intense, and as the fluid accumulates the membrane bulges,—a certain indication (in some instances a late sign) for incision of the membrane. If spontaneous perforation has occurred, pulsation synchronous with the heart's action is seen through the membrane, and this is quite characteristic of acute tympanic suppuration. On account of the extreme congestion, greater or less ecchymosis, and macerated epithelial debris, it is most difficult to determine where the external wall ends and the membrana tympani begins. The perforation may be situated in any part of the membrana tympani, and ranges from the size of a pinpoint to that of a small bean, or may even extend to total destruction of the membrane. The larger

perforations are apt to occur in cases complicating the exanthemata.

ETIOLOGY.—The etiology of this disease is the same as that given under acute catarrhal otitis media. In addition, infection frequently arises through extraction of foreign bodies from the external auditory canal, and from injuries. In view of the fact that the caliber of the Eustachian tube is relatively larger in young children than in adults, it must be remembered that a suppuration of the middle ear may actually take place without perforation of the membrana tympani, the fluid escaping under more or less pressure by way of the tube into the nasopharynx. This, no doubt, explains why the severe pain of an acute otitis media frequently subsides without apparent cause, only to return again, in the average case, as the tympanic cavity refills and pressure is exerted on the inflamed mucous membrane. This process may be repeated several times, the case eventually recovering without perforation of the drumhead. Those attacks complicating the exanthemata, typhoid fever, and pneumonia are especially prone to become suppurative and should, therefore, be anticipated and detected by an early examination.

PATHOLOGY.—In addition to that given under acute catarrhal otitis media, the pathological changes are simply those incident to the advanced stage of the disease. When the mucous membrane lining the tympanic cavity becomes greatly inflamed and edematous, and pressure from accumulated fluid increases, the mucosal covering becomes macerated and frequently peels off, exposing the unprotected underlying osseous struc-

ture to the ravages of the various micro-organisms. Herein lies the starting point of carious erosion in various directions, leading to the subsequent establishment of intracranial lesions.

PROGNOSIS. — Uncomplicated suppuration ends usually, under prompt care, in complete recovery, both as regards a cessation of discharge and restoration of hearing to about normal. If ankylosis of the ossicles has taken place, with adhesions between the membrana tympani and tympanic wall, impairment of hearing, as well as tinnitus aurium, will be present. A permanent perforation may also be the cause of some loss of hearing. Complications liable to occur during an attack of acute suppurative otitis media are enlargement of the cervical glands,—rather common in children,—acute mastoiditis, acute involvement of the internal ear, facial palsy, sinus thrombosis, and intracranial complications, such as meningitis and brain abscess formations.

TREATMENT.—In the mild type of case it is best to try to reduce the inflammation by the application of



Fig. 3.—Myringotomy knives, sharp and blunt pointed.

treatment as outlined under acute catarrhal otitis media. When this fails promptly to abate the symptoms, one's efforts must be directed toward the establishment of **free drainage** and the **prevention of various complications**. The most important procedure, therefore, is the early and free **incision of the membrana tympani**,

and although the rule still prevails, in the usual case, to wait until the drumhead bulges, this is a late and unsafe indication in acute suppuration of the middle ear complicating the exanthemata and influenza. It is

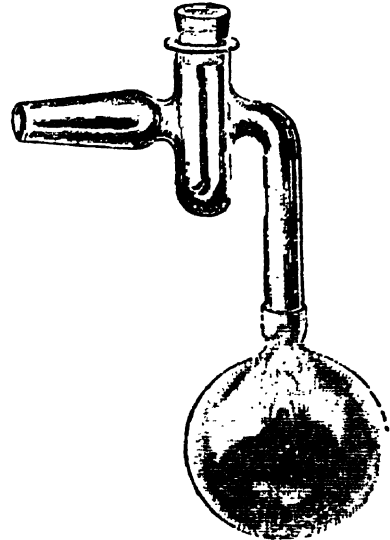


Fig. 4.—Aspirator.

best, therefore, in all severe infections to incise the membrana tympani early, as this is our best means of preventing additional complications.

When the case is seen sufficiently early, the drumhead should never be allowed to rupture spontaneously, as it is in such cases that complications most frequently occur. In the event of a spontaneous rupture (and this only too frequently happens), if the opening is small or situated high up, so that drainage takes place by means of overflow, the opening should be enlarged.

Before incision of the membrana tympani is undertaken, the same thorough surgical preparation, both for patient and operator, must be observed as in major operations, such as that upon the mastoid process.

Free evacuation of pus from the

tympenic cavity can never be accomplished by a simple puncture or paracentesis of the membrana tympani. The membrane must be freely incised, the chief requisite being to carry the incision from the most dependent part downward to the lower border of the canal, said incision to be continued either in an anterior or posterior direction until about one-fourth of a circle has been formed (Fig. 3). This will not only provide for good drainage, but will insure patency of the opening long enough to admit of proper after-treatment. Following a free incision, **aspiration of the tympanic cavity** is advisable, as this will relieve the congested

The local treatment is usually of two types, known, respectively, as the "wet" and "dry" methods. It is necessary to employ the *wet method* in those cases that cannot be more or less constantly under the physician's care, and also where the discharge is profuse. The wet method consists of the use of various **warm medicated solutions**, by means of a **syringe** or **irrigation bag**, or the **instillation** of drops into the ear.

After the establishment of drainage, the more simple cases will improve upon **removal of all secretion** by means of cotton on a cotton-carrier (Fig. 5) or the syringe (Fig. 6), after which a **warm saturated boric**



Fig. 5.—Applicator.

mucosa of considerable blood and thoroughly evacuate the pent-up secretion.

Although incision of the membrana tympani can be performed under **local anesthesia**, it is always better to administer **general anesthesia** when possible. **Nitrous oxide gas** can be employed for this purpose to great advantage. **Ether** still remains the safest and most popular drug for general anesthesia. If for any reason it is desirable to use local anesthesia, the drumhead can, in some instances, be thoroughly anesthetized by applying to the same a solution composed of equal parts of **cocaine**, **menthol**, and **phenol**. A small piece of cotton may be moistened with this solution and placed against the membrana tympani, where it should remain fifteen minutes before the drumhead is incised. The patient should be kept in **bed**, given a **light diet**, and **freely purged**.

acid solution should be instilled into the ear and allowed to remain five minutes. This should be repeated every three hours. Should this simple treatment fail, astringent solutions are indicated, such as **zinc sulphate**, **copper sulphate**, or **lead acetate**, in the proportion of 5 to 8 grains (0.3 to 0.5 Gm.) to the ounce (30 c.c.) of water. **Silver nitrate**, 5 to 10 grains (0.3 to 0.6 Gm.) to the ounce of water, is especially efficacious in some cases. Where the discharge is persistent, the efficiency of the treatment will depend somewhat on a more or less frequent change of the medication.

The *dry method* of treatment can only be instituted when the acute inflammatory stage subsides, and where the perforation is large and the discharge not abundant. It consists of wiping out the secretion with some antiseptic solution and then dusting the surface with impalpable powder

by means of a powder blower. For this purpose **boric acid** or **aristol** is usually employed, or a combination of both in equal parts. Care should be taken only to *dust* the surface with the powder, as any excess will interfere with free drainage.

Every effort should be made, by **internal medication**, **diet**, and **out-of-door life**, to improve the patient's general health. In the past few years **hexamethylenamine** has been administered internally with a view to favorably influencing the course of the disease. Personally I doubt very much its efficiency, even in large doses.

After the acute symptoms have subsided, one should **inflate** the middle ear 2 or 3 times a week, gradually decreasing the frequency, and finally ceasing entirely as the hearing improves.

CHRONIC SUPPURATIVE OTITIS MEDIA (Otitis Media Chronica Purulenta).

DEFINITION.—A chronic purulent inflammation of the middle ear.

SYMPTOMS.—The chief characteristic of chronic suppurative otitis media is that the patient does not ordinarily complain of pain, but has a more or less constant discharge from the external auditory canal. A discharge mixed with blood-corpuscles indicates the presence of granulations or polypi. If it be brownish or brownish yellow in character, with a fetid odor, there is in all probability caries and necrosis of the bony structures of the tympanic cavity, antrum, or mastoid cells. A profuse discharge strongly indicates involvement of the mastoid process.

So long as the perforation is large and the discharge is not obstructed

by granulations or polypoid growths, the patient suffers no inconvenience, and may, therefore, continue in this state for years without any annoyance except that of a "running ear." If for any reason, however, the discharge becomes obstructed in its egress either from the mastoid process or the middle ear, the patient will probably have a rise of temperature and will suffer from headache or a feeling of heaviness and fullness in the head, or pain in the ear, all of which may continue for a time and be relieved on the reappearance of the discharge.

A perforation situated in Shrapnell's membrane indicates a disease of

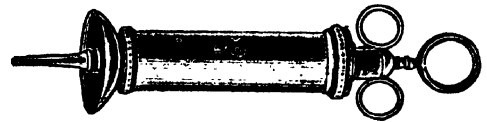


Fig. 6.—Ear syringe.

the attic as well as involvement of the ossicles. When located in the superior and posterior quadrant, it is usually associated with disease of the antrum or mastoid cells and the ossicles. If located in the anterior and inferior quadrant, it indicates catarrh of the Eustachian tube or disease of the osseous structure around the tympanic orifice of the tube.

Cholesteatomatous masses are sometimes found within the tympanic and mastoid cavities. Such a mass is composed of an accumulation of desquamated epithelium from the lining membrane. A *cholesteatoma* somewhat resembles an onion in shape and formation, is grayish white in color, and can be peeled off like an onion. The probabilities are that bone necrosis has something to do, also, with the formation of

cholesteatoma. Cases of this type seldom recover without operative intervention.

The hearing is always somewhat impaired, and occasionally markedly so. The average case hears better while the ear is actively discharging, provided the secretion is not too abundant. This is probably due to the fact that the secretion favors the conduction of sound waves.

Unless suffering is present or some other condition arises, such as a sudden facial palsy, an intracranial complication, or a septic infection of the lateral sinus, the average case, untreated, will continue indefinitely.

ETIOLOGY.—As already stated, an acute suppurative inflammation of the middle ear is a continuation of an acute catarrhal process. A chronic suppurative process is likewise a continuation of an acute suppurative otitis media. The acute form of suppuration is frequently due to neglect or inefficient treatment of the catarrhal stage. It is also true that a chronic otorrhea is usually the result of neglect or inefficient treatment of the acute suppurative form. However, there are a good many general causes which tend to prolong the disease, such as pneumonia, syphilis, tuberculosis, diabetes, insufficient food, and unhealthful surroundings. For these reasons, chronic middle-ear suppuration is more common among the poor than the well-to-do.

PATHOLOGY.—Owing to the extensive round-celled infiltration, due to chronic inflammation, the mucous membrane is greatly thickened. Some parts of this membrane are swollen, while others are denuded of epithelium, the result being erosion, ulceration, peeling off, and exposure of the

bone, with consequent caries and necrosis. As the inflammation subsides, new connective tissue has a tendency to bind the ossicles together, causing complete ankylosis, and adherence of the ossicles and fragment of drumhead to the tympanic wall. Granulations and polypi frequently result from local proliferation of the tissues. The mastoid process, the labyrinth, or the interior of the skull may all become secondarily involved.

PROGNOSIS.—The prognosis in chronic suppurative otitis media is always problematical. Even when a discharge has ceased without operative intervention, one can never be certain that it will not recur. Indeed, it is from the recurrent type of case, even though the discharge may have ceased for some months or even a few years, that the majority of the cases of intracranial complications arise. On the other hand, if the discharge has ceased, under treatment, before extensive carious erosion has taken place, and the patient is healthy, the prognosis is favorable. It must not be forgotten, however, that an occasional case will discharge continuously or recurrently for a number of years and then permanently cease suppurating after the discharge of a small sequestrum; but it is always a dangerous procedure to wait for such an occurrence.

TREATMENT.—For success in treatment, each case must be considered separately from the viewpoint of its own particular characteristics, *i.e.*, it is impossible to outline a routine treatment for chronic suppurative inflammation of the middle ear with the idea that it will be efficacious in any great number of cases. This ap-

plies to the practice of constant syringing, as well as to the adoption of the usual surgical procedures for the relief of the discharge. From the fact that a discharging ear must always be considered dangerous to the health or even the life of the individual, the rule prevails that if a given case fails to yield to non-surgical treatment, more especially in the presence of extensive attic caries or cholesteatomatous masses, surgical intervention is called for. To be conservative, the first procedure should be the **removal of all inflammatory débris** and an **ossicectomy**, provided the symptoms do not de-

nitrate, to the ounce (30 c.c.) of water. These solutions are to be *warmed* and dropped into the ear after it has been thoroughly cleansed by syringing and then dried. They are used to the best advantage by placing the head on a table, with the affected ear uppermost; the canal is then to be filled with the medicinal solution, which is allowed to remain about five minutes. When the attic is especially involved the solutions can be used to advantage by means of the **tympanic syringe** (Fig. 7).

Except for the use of the tympanic syringe, this treatment can usually be carried out at home, from 1 to 3

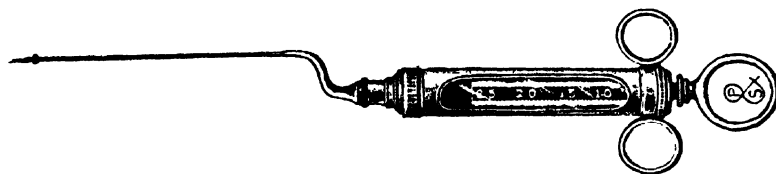


Fig. 7.—Tympanic syringe.

mand a radical mastoid operation. Ossicectomy failing to effect a cure, a **mastoid operation**, usually of the radical type, is indicated.

Whatever the line of treatment, the object is to bring about a cessation of the discharge, and this is accomplished, in the average case, where the discharge is profuse, by first **syringing** the ear, to rid the canal and tympanic cavity of secretion, and then drying it.

Following this, in some cases, the insufflation of **boric acid powder** or a combination of **boric acid** and **zinc oxide powder** in equal parts will act very satisfactorily. It will be necessary, at times, to use astringent solutions, *e.g.*, from 5 to 8 grains (0.3 to 0.5 Gm.) of **zinc sulphate**, **copper sulphate**, or **lead acetate**, or 10 to 20 grains (0.6 to 1.2 Gm.) of **silver**

times a day, according to the severity of the case.

If granulation tissue or non-fibrous polypoid growths be present, they can usually be eradicated by the use of **alcohol drops** in the manner described above. It is well, in the average case, on account of the pain caused by pure alcohol, to dilute it one-half with **boroglyceride** or plain **glycerin**. As the solution is used, the bottle containing it may be kept filled with alcohol, which will gradually replace the glycerin, until finally pure alcohol is used.

When the perforation is small and the discharge continuous, it is necessary to enlarge the former to provide for better drainage and to insure that the solutions and applications shall come into direct contact with the inflamed mucosal lining of the middle

ear. It must be remembered that frequent syringing is apt to keep up the discharge in some cases, in which event it is better to resort to the so-called "dry" treatment. This, as above stated, is applicable to those cases where the discharge is not too profuse, and consists of wiping out the external auditory canal, and middle-ear cavity if the opening in the drumhead is sufficiently large, with cotton on a cotton-carrier, and then applying one of the astringent solutions above mentioned, after which the entire surface is dusted with **boric acid powder** or equal parts of **boric acid** and **zinc oxide** powder, or **aristol**, plain or in combination with **boric acid**. All solutions and drops should be sterile so far as possible, and should be warmed before use. The following solutions are ordinarily used for syringing and irrigating the ear: Saturated **boric acid solution**, **normal salt solution**, 1 per cent. **lysol solution**, and 1:5000 or 1:10,000 solution of **potassium permanganate**.

The use of **autogenous** or **stock vaccines** has come into vogue in recent years, with more or less reported success. My personal experience has been decidedly disappointing, but it is well, in some instances at least, to employ this therapeutic measure. Various **caustics** and the **galvano-cautery** are at times used for the destruction of granulation tissue and polypoid growths, but as a general thing it is better to remove these by surgical means. If this, in connection with the above-mentioned non-surgical treatment, does not cure suppurative otitis media, then one must seriously consider the advisability of more extensive surgical intervention. The first step in this, in the absence

of urgent symptoms, is an **ossiculotomy**, to be followed later, should it fail to effect a cure, by a radical **mastoid operation**.

CHRONIC CATARRHAL OTITIS MEDIA (Otitis Media Chronica Catarrhalis).

DEFINITION.—A chronic catarrhal inflammation of the middle ear.

SYMPTOMS.—There are three principal symptoms of this disease: The first is a slowly progressive deafness, unrecognizable, in some instances, until the hearing in one ear is greatly impaired. Noises in the head, except in otosclerosis, are secondary to the impairment in hearing, and yet, on account of the slow progress of the latter, tinnitus aurium is frequently the first symptom of which the patient complains, and he is surprised when informed of his loss of hearing. When the second ear becomes involved, progress is frequently very rapid, the patient in such circumstances quickly losing much hearing. Attacks of dizziness and vertigo are later manifestations, and often are indicative of internal ear involvement. The symptoms are usually aggravated in damp weather.

Nearly every case gives a history of frequent "colds in the head," at which times the symptoms are increased. On relief from the coryza, the deafness and noises gradually subside and for the time being may even seem to disappear. It is doubtful, however, whether the ear ever entirely recovers itself following these attacks. The rule is that each attack adds somewhat to the progressive loss of hearing. Fatigue, mental troubles, and impaired health adversely affect the hearing. Unless the internal ear becomes secondarily

involved, complete deafness never occurs.

Notwithstanding that deafness is inconvenient and annoying, yet it is nothing compared to the distressing symptom of tinnitus aurium. The noises may be of any type, the more common being the hissing of steam, buzzing sounds, hammering, and those of a pulsating character. They are usually intermittent at first, later becoming constant, and frequently disturbing the patient's slumber. In extreme instances patients court death rather than endure this incessant torture.

The attacks of vertigo vary from slight giddiness, almost unrecognizable, to ones of such severity that the patient suddenly falls. These attacks occur in the later stages of the disease. When the stapes become firmly fixed in the fenestra ovalis, nausea and vomiting, together with a marked increase in the deafness and tinnitus, frequently develop. These attacks, known as *Ménière's symptom-complex*, closely simulate true Ménière's disease.

Actual pain is sometimes experienced on hearing loud noises, a condition known as *hyperesthesia acoustica*. A symptom considered unfavorable is known as *paracusis Willisiana*, or hearing better in a noise; this occurs in late stages of chronic catarrhal otitis media or otosclerosis.

The membrana tympani is usually thickened and retracted, the latter condition being due to obstruction of the Eustachian tube and the former to inflammatory changes. The drum-head may be uniformly opaque or its opacity may appear in patches. Chalky and calcareous deposits are sometimes seen. In the atrophic type

of case the membrana tympani, as well as the mucous membrane of the tympanic cavity and tube, becomes very thin. If the patient suffers from a hypertrophic nasopharyngitis or an atrophic nasopharyngitis, the same condition is very apt to be reflected in the organ of hearing.

In uncomplicated middle-ear catarrh tuning forks of high pitch are well heard, bone conduction is good, and Rinne's test is either partially or wholly negative. As the internal ear becomes involved, there is a gradual loss of bone conduction and perception of high-pitched notes.

ETIOLOGY.—This disease, in so far as we are able to determine, is the result of repeated attacks of the acute or subacute varieties. The onset is usually so gradual that often the patient is not aware of any aural abnormality until he suddenly discovers the unmistakable symptoms of well-advanced catarrhal otitis media, such as a loss of hearing or the advent of tinnitus aurium in one or both ears. Ordinarily the two ears are not simultaneously involved to the same extent. In such cases it is most difficult to assign an actual cause for the condition. As is the case in most other ear diseases, this is unquestionably an extension of a similar disease from the nasopharynx; consequently, any abnormality of this region, especially in the form of a more or less continuous congestion, must be considered as a predisposing cause. This congestive state is largely enhanced by the excessive use of tobacco (more especially cigarettes) and alcohol, obstructed nasal respiration, a dusty atmosphere, and unhealthful surroundings. Systemic diseases, such as syphilis, Bright's

disease, rheumatism, and gout, are also predisposing factors.

It is doubtful whether heredity plays an important part in the causation of chronic catarrhal otitis media, unless to this cause can be attributed that variety known as *otosclerosis*, or inflammation of the labyrinthine capsule. Hereditary *otosclerosis* does seem actually to exist in families and connections where the ancestors for several generations have been afflicted with gout. Chronic catarrhal otitis media is essentially a disease of adult life.

PATHOLOGY.—When catarrh persists, the mucous membrane re-

PROGNOSIS.—Very much depends on the patient's general health, as well as the changes that have taken place in the tympanic cavity and labyrinth, at the time he seeks treatment. Unquestionably the average case is amenable to treatment if seen in the early stage, *i.e.*, before the changes above mentioned have taken place; whereas in advanced cases all that one can hope to accomplish is the alleviation of symptoms and the arrest of the disease. In extreme cases one is often unable to effect any betterment; indeed, these cases usually go from bad to worse regardless of what may be done for them.

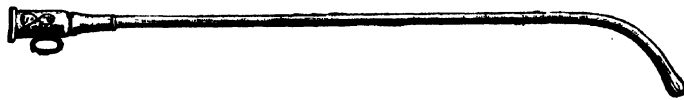


Fig. 8.—Eustachian catheter.

mains swollen from round-celled infiltration. The hypertrophic mucosal lining filling the niches of the round and oval windows binds down the ossicles, greatly interfering with their mobility, and thereby causing much impairment of hearing. In the absence of resolution, histological changes transform this hypertrophic tissue into new connective tissue, with resultant adhesions between the ossicles and the inner wall of the tympanic cavity.

In the same manner a stricture of the Eustachian tube may develop, while, on the other hand, atrophy of the tympanic mucosal lining and of the membrana tympani may take place.

What was formerly known as "chronic dry catarrh" is now recognized as a disease of the labyrinthine capsule, *otosclerosis*, a condition still much discussed.

TREATMENT.—As in other forms of aural disease, every effort must be made to **remove the cause**, which commonly resides in the nasopharynx. By the time the usual patient seeks relief, gross pathological changes which necessarily prevent a complete restoration to the normal have already occurred. One's efforts, then, must be directed to the alleviation of symptoms and the arrest of the process. Undoubtedly certain cases are made worse by meddling treatment.

Therapeutic measures should consist of the application of **local treatment** to the ears, of the **correction of nasopharyngeal disease**, and of efforts toward the **betterment** of the patient's **bodily health**. **Inflation of the tympanic cavity** through the Eustachian tube is carried out either by Politzer's method or the use of the Eustachian catheter. (Fig. 8.) It is well to **determine in advance**

whether the individual case is of the *atrophic* or *hypertrophic* variety. In the latter instance some difficulty may be experienced in rendering the tubes patulous; in the former much damage is frequently done by using undue force in a tube already abnormally patulous because of atrophic changes, the injury being either to the membrana tympani or to the labyrinth. A few drops of **chloroform** in the bag will facilitate tympanic inflation.

If the membrana tympani is firmly adherent to the tympanic cavity no

under these circumstances it should be continued, provided it does not actually impair the hearing power.

Medicated vapors and fluids, introduced by bag and catheter through the Eustachian tube, are commonly used. I have great doubt, however, as to their actual efficiency. The probabilities are that the chief benefit derived is from the act of inflation itself, rather than directly from the vapor or fluid. Alexander Randall reports good results from injecting a solution of **dionin**, 5 to 8 grains (0.3 to 0.5 Gm.) to the ounce, through the

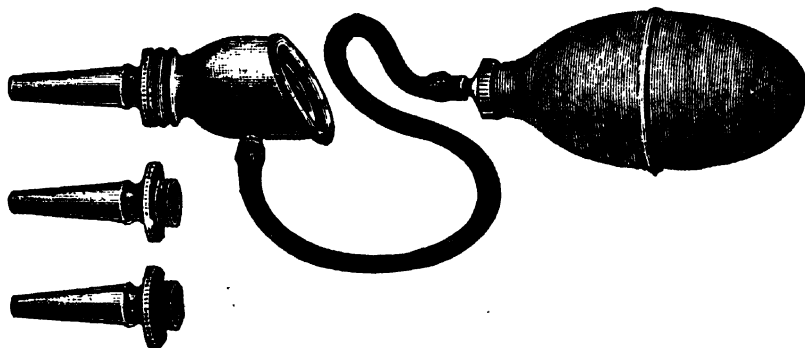


Fig. 9.—Slegle's otoscope.

improvement will follow inflation. If it is not adherent, on the other hand, even though it be in actual contact, much improvement frequently follows inflation. If no improvement is noted after inflation when the treatment has extended over several days, the case is not a very hopeful one, and this particular line of treatment should be less frequently used or altogether abandoned. Should inflation by Politzer's method or the use of the Eustachian catheter result in improvement, the same measure should be employed about twice a week as long as the benefit continues. In some instances inflation will be beneficial to the tinnitus even though it does not improve the hearing, and

catheter and Eustachian tube into the middle ear. **Liquid petrolatum** and **zinc oleate** are also used, in the same manner. A 2 per cent. solution of **pilocarpine**, as first suggested by Politzer, is still a favorite medication, especially when syphilitic involvement is suspected or actually present. A 10 per cent. aqueous solution of **potassium iodide** is used in similar cases. All solutions and instruments, and the nasopharynx so far as possible, should be thoroughly sterile. It must be remembered, also, that even though solutions be sterile, they are apt to induce an acute middle-ear inflammation if too large a quantity is used, 2 or 3 drops being sufficient. Three or four days

should elapse between treatments of this type.

Bougies are used to determine the existence and location of a stricture, as well as to dilate it, and to apply local therapeutics if a medicated bougie is employed. They are resorted to when other methods fail to render the tubes patulous, and should be used only by experts.

Treatment by way of the Eustachian tube may be supplemented by **vibratory massage** through the external auditory canal. For this purpose Siegle's otoscope (Fig. 9) or other similar appliances, some of which are run by electricity, are of undoubted value, more especially in the hypertrophic form of the disease. In using Siegle's otoscope, great care must be taken that the bulb is compressed before the aural tip is introduced into the meatus, as otherwise the effect would be to push an already retracted drumhead and impacted stapes into still more abnormal positions. These aural gymnastics are indicated in all hypertrophic cases except where the malleus is adherent to the promontory. In such cases the effect would be to relax still further the membrane on each side. Generally speaking, aural massage is contraindicated in the atrophic variety of cases.

If dizziness and vertigo persist and become extreme, the labyrinth is usually seriously involved.

Dividing the adhesions that bind down the drumhead and ossicles to the promontory offers a means of improvement in those well-advanced cases where ossicular ankylosis is not complete and the labyrinth is not unduly involved.

Various operations on the mem-

brana tympani and partial or complete **extraction of the ossicles** have been suggested and frequently performed in the past, without sufficiently permanent results to warrant serious consideration except in extreme cases in which other therapeutic measures have failed to give relief.

Improvement of the general health, by whatever means will promote its betterment, should be given careful consideration. The internal administration of **compound wine of iodine**, which contains $\frac{1}{6}$ grain (0.01 Gm.) each of iodine and bromine and $\frac{1}{100}$ grain (0.0006 Gm.) of phosphorus to the dram (4 c.c.), has given very satisfactory results. This remedy, to be efficient, should be continued over a long period of time, and has the advantage of acting as an alterative tonic without in any degree interfering with the patient's digestive apparatus. The administration of full therapeutic doses of **strychnine**, alone or in combination with the **glycerophosphates**, is of value. **Syrup of iodide of iron** is frequently prescribed. **Ergot**, in rather full doses, is sometimes beneficial for the relief of tinnitus aurium, more especially the pulsating type.

Derangements of the thyroid gland are unquestionably responsible for some cases of impaired hearing accompanied by tinnitus aurium. These cases will not only improve, but, as a rule, entirely recover, upon administration of appropriate doses of **thyroid extract**. The patient should lead as much of an **out-of-door life** as possible, and take moderate **exercise**. Those living in low regions, with a moist atmosphere, will frequently be benefited by going to a **greater alti-**

tude, with clear atmosphere; while the reverse is true of those living in great altitudes.

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MIGRAINE. See NERVES, PERIPHERAL, DISEASES OF.

MILIARIA (PRICKLY HEAT).

—**DEFINITION.**—Miliaria (prickly heat; lichen tropicus; miliaria rubra; miliaria alba) is a vesicular eruption of the skin characterized by discrete, but closely set, pinpoint- to pinhead- sized papules and vesicles occurring at the mouth of the sweat-ducts, accompanied by itching and burning, and due to profuse sweating.

SYMPTOMS.—The eruption of miliaria consists of minute vesicles developed near the pores of the skin. These may be acuminated and red (lichen tropicus) and discrete and irregularly dispersed over the surface; or, they may be confluent and red at the base (red miliaria). At first they contain a pellucid fluid, which occasionally tends to become turbid, then purulent. The eruption is apt to present in parts of the body covered by clothing. The vesicles usually dry up into minute scales. Sometimes the case is attended by lesions simulating those of eczema.

The active symptoms generally consist of a prickling sensation as if thousands of needles were being forced into the skin. This is followed by pruritus, and the case then proceeds to recovery if the irritating factor (heat) is avoided.

DIAGNOSIS.—Miliaria is distinguished from eczema by the sudden, profuse occurrence of the eruption following sweating, by the discreteness and non-coalescence of the lesions, by the absence of weeping, and by the spontaneous cure on the appearance of cooler weather.

ETIOLOGY AND PATHOLOGY.—The immediate causes of miliaria are excessive stimulation of the sweat-glands and unusual activity of function, brought on by exercise during the summer, or exposure to severe heat. In tropical climates it may occur at any time during the year, but in the temperate zone it is met with only during warm weather.

Too heavy or too light clothing may aid in its development. Children and the obese are more liable to attacks of the papular variety; also persons of nervous temperament and fair complexion. Weak and anemic persons—pale, overworked women; puny, ill-fed infants, and young children—are more subject to the vesicular form.

Pearse believes that the sebaceous glands are the etiological factors, and states that their own secretion causes an acute obstruction which is secondarily maintained by the continued irritation of excessive perspiration. He bases his opinion on the fact that the disease is limited to those parts of the skin containing sebaceous follicles. Robinson states that the inflammation is about the sweat pores, while Török holds that it is due to an irritation of the skin produced by the sweat and entirely independent of the sweat pores. In this latter opinion Castellani concurs.

In an examination of histological specimens removed from patients of different ages, and from different portions of the body, Politzer found that the same conditions were present in all of the sections—an edematous rete Malpighii, containing dilated sweat-ducts, with no change in the cutis except in the papillary layer, the horny layer of the epidermis being swelled by imbibition.

TREATMENT.—The treatment is mainly prophylactic: measures calculated to reduce undue exposure of the body to heat. When unavoidable climatic conditions act as cause, frequently repeated **bran baths** (a pound of bran packed in a towel being allowed to soak) are sometimes very soothing. A solution of **ammonia**, a tablespoonful to a quart of water, generally allays the itching very promptly. Sponging with **lime water** is preferable in children.

Pearse advises the use of a mixture of **sweet almond oil** and **lanolin** (8 to 1), the parts being anointed night and morning and gentle massage of the skin used at the same time. As the excessive perspiration is liable to cause eczema intertrigo, **drying powders** for the axillæ, under large mammæ, and between the skin folds of fat people are useful. On the prickly

heat, they seem to have little control. Petrolatum does not take the place of oil.

In the graver form Holstein states that **thorough cleanliness** must be insisted upon; the clothing should be boiled, and **sublimate washes** or **ointments** employed. In some cases the crusts of the lesions may be removed and **hydrogen dioxide** applied. This should be repeated daily for several days, antiseptic ointments being applied between-times. The hydrogen dioxide may be injected into the boils. **Phenol, menthol, aristol, euophen, resorcinol**, etc., and lotions of **ichthyol** (2 to 5 per cent.) made with a saturated solution of **boric acid** are recommended by other authors.

W.

MILIARY FEVER (SWEATING SICKNESS). — DEFINITION.

—An infectious disease characterized by an acute inflammation of the sweat-glands, accompanied by the appearance of small vesicles, much burning, itching, pains, fever, and chills, and extraordinarily profuse sweats, usually affecting adults between the ages of 20 and 40. Vignol reported an epidemic of 6256 cases, with a mortality of 2 per cent. Weichselbaum, in 1907, reported 3 epidemics. In the first, 57 persons were attacked, 24.5 per cent. of whom died; in the second epidemic there were 34 cases, with a mortality of 32.3 per cent., and in the third 126 persons were affected, the mortality being 16 per cent. Scholtz, in 1906, reported an epidemic of 126 cases, the mortality being 16.7 per cent., this being about 2.5 per cent. of the population.

SYMPTOMS.—These are fever, with its usual phenomena, irritation of the skin, epigastric oppression, profuse and persistent sweating, followed, on the third or fourth day of the disease, by an eruption (due to the profuse diaphoresis) of miliary vesicles accompanied by much burning, itching, and pain. The vesicles burst, and within forty-eight hours the disease is terminated by a scaly desquamation. In severe types grave nervous phenomena (delirium, etc.) are present, hemorrhages may occur, and fatal collapse may ensue. Relapses are not uncommon.

ETIOLOGY AND PATHOLOGY.—Chantemasse advances the hypothesis

that field rats are responsible, primarily, for the transmission of miliary fever and for the epidemics. Among these arguments are the facts that the disease is never observed in cities; the absence of direct contagion; that the regions affected in the large epidemics were always and exclusively those that had been ravaged by field rats during the previous few years, while other regions, free from rats, escaped; the epidemics broke out after an unusually wet season which had driven the rats from their haunts to seek shelter in the houses, and, finally, that the persons affected all showed evidences of flea bites and attributed the unprecedented swarms of fleas to the invasion of homes by the rodents. Another argument was the rapid spread of the disease. In the epidemic reported by him the disease spread over 3 provinces in forty-five days, affecting 6000 persons. Most epidemics occur in spring and summer. The disease is more common among women than men, and most frequent in middle life.

Weichselbaum asserts that the sudamina, whether nodular or vesicular, containing clear or milky fluid are never caused by a retention of fluids in the sweat-glands, but are always of an inflammatory nature, as shown by serial sections. The lesions are found, principally, in the epidermis, though some changes are present in the corium. The disease does not appear to be contagious.

PROGNOSIS.—This varies with the character of the epidemic, the average mortality apparently being 8 or 9 per cent., though it may reach as high as 32.3 (Weichselbaum).

TREATMENT.—There is no prophylactic measure save **disinfection**. There is no specific treatment. The sweating may demand **atropine** for its control. **Sedative** remedies may be employed to overcome the marked nervousness frequently noted at the beginning of the disease. **Quinine** has been generally used to control the fever. The expectant plan of treatment has found most favor, the indications being met as they appear. **Calomel** in small doses, when administered early, is believed to shorten the disease. **Luke-warm bran baths** or **sponging with lime water** assist in allaying the itching and

encourage resolution. The **body covering** should be **changed as often** as it becomes soaked with perspiration. The **diet and bowel functions** should be **regulated** as in other acute fevers. W.

MILIUM.—Milium (grutum; strophulus albidus) is a cutaneous disorder characterized by the formation of small, roundish, whitish or pearly, sebaceous, non-inflammatory elevations, situated just beneath the epidermis, which are formed by the accumulation of inspissated sebum in ducts the outlets of which have become occluded. They are mainly found on the face, eyelids, and foreheads of elderly persons; may exist in large numbers, and vary in size from a pinhead to a small pea. They may undergo calcareous degeneration, giving rise to cutaneous calculi.

According to Pusey, milium is most frequently the result of the growth of the horny epidermis over the mouth of the sebaceous follicle, this being followed by retention of sebaceous matter beneath the horny epidermis. The lesions differ from comedones only in that the contents of the distended duct cannot be squeezed out until an opening is made. Milium is often associated with comedo and acne. When present in infants milium usually disappears spontaneously after a time, but in adults there is no similar tendency.

TREATMENT.—A small **incision** over the elevation will afford an exit through which the contents may be expressed by squeezing. After evacuation the interior should receive an application of **silver nitrate** (solid stick) or of **tincture of iodine**. **Electrolysis** may also be resorted to. Where the milia are numerous and close together the use of a **peeling paste** or of **soft soap** long enough to bring on a mild dermatitis (Stelwagon) will often result in their exfoliation. In children extra care as to the cleansing of the skin and the use of a weak **sulphur ointment** are likely to prove effectual. S.

MILK SICKNESS.—This is a disease of cattle (the "trembles," "slows," "alkali poisoning"), but occasionally observed in women and communicated to them by using the flesh or milk of animals suffering from the disease. In cattle it is

due to the ingestion of various toxic plants, such as snakeroot, *Rhus toxicodendron*, the rayless goldenrod, etc., and is usually met with on the banks of streams.

Experiments on rabbits showed that trembles and milk sickness are due to aluminum phosphate. In Ohio and Illinois animals get this substance by eating white snakeroot, in New Mexico by eating the rayless goldenrod. In the northern States, wherever trembles prevails, the white snakeroot grows abundantly. The writer knows of a number of cases of trembles following the eating of this weed by animals in the woods. On the other hand, they may eat small amounts without serious effects. The weed grows in many places where trembles is unknown, but in these places better-tasting plants are so much more abundant that white snakeroot forms but an insignificant part of their food. Moseley (Med. Rec., May 15, 1909).

SYMPTOMS AND PATHOLOGY.—

The symptoms in the main are persistent vomiting, obstinate constipation, sweetish acetone odor of the breath, muscular weakness, abdominal pain, and prostration. There is little or no fever; little is known as to the incubation period.

According to Jordan and Harris, who studied the pathology of the disease in cattle, the chief pathological lesions were found in the liver, heart muscle, kidneys, and small intestine; the changes are those of a parenchymatous nature, such as are frequently produced by toxic action in general; namely, cloudy swelling and fatty metamorphosis. The severest action is shown in the liver-tissue. In other organs than those mentioned above, nothing of very particular interest was observed as yet. Bacteriological studies revealed the presence in the tissues and body fluids of infected animals of a bacillus which they termed *Bacillus lactimorbi*, but whose direct connection with the disease is still *sub judice*.

TREATMENT.—The treatment consists in removing all possible causes and in aiding the autoprotective resources of the body to overcome the pathogenic agent. Besides tonics, the use of **creosote**

carbonate to act as antiseptic, and sodium benzoate and copious draughts of water to facilitate renal elimination, is indicated.

S.

MINERAL SPRINGS AND CLIMATOLOGY.

MINERAL WATERS FOR INTERNAL USE.

CLASSIFICATION. — Mineral waters for internal use are usually classified on a chemical basis, but for medicinal purposes are best arranged on a therapeutic basis, as suggested by Huggard:—

Group A. Depurative.

I. *Abluent*:—

1. Simple thermal waters.
2. Sulphur waters.

II. *Stomachic and Diuretic*:—

1. Simple aerated or table waters, called also acidulated waters, containing free CO₂.
2. Simple alkaline waters, containing at least 15 grains (1 Gm.) of sodium bicarbonate in a quart (liter) of water.
3. Alkaline salt waters, containing the chloride as well as the bicarbonate of sodium.

III. *Mild Intestinal Stimulants*:—

1. Salt waters, of which the chief ingredient is common salt or sodium chloride. They are divided into simple salt waters and carbonated salt waters, according to the absence or presence of carbonic acid.
2. Alkaline aperient waters, of which the chief ingredient is Glauber's salt (sodium sulphate).

IV. *Strong Aperients*:—

Of which the chief ingredient is Epsom salt (magnesium sulphate).

Group B. Tonic and Reconstituent.

I. *Hematogenic*:—

1. Of which the chief ingredient is iron.
2. Of which the chief ingredient is lime.

II. *Alterative and Nervine*:—

1. Of which the most important ingredient is arsenic.
2. Of which the most important ingredient is barium chloride.

Lithium occurs frequently in alkaline waters; *iodine* and *bromine* occur in saline waters. None of these substances, however, is present in sufficient quantity to modify in any important degree the therapeutic action of the water. The presence of helium and argon renders many mineral waters radioactive.

A. DEPURATIVE.

I. ABLUENT.

1. SIMPLE THERMAL WATERS.—

These waters are characterized by their elevated temperature and by the low salt content. Some of these emerge at a temperature of 66° F. (19° C.); others at varying temperatures up to 158° F. (70° C.) or even 214° F. (101° C.). These waters are soft, due to the presence of sodium bicarbonate, instead of calcium carbonate which is found in hard spring water. Though soft, they have a pleasant taste. Many of these simple warm springs are chiefly used for baths (the external uses of water, including baths, will be treated under "Water").

Physiological Action. — The physiological action of the simple thermal waters is the same as that of plain warm water. The observations of Glax and Klemensievs show that the drinking of hot water lowers the arterial tension, although the pulse is accelerated; the respiration is more frequent immediately after the drinking, and that, systematically continued, hot water drinking induces a permanent relaxation of the arterial walls. Winternitz had previously observed similar effects. The action of the water on the pulse is evidenced before the water can be possibly absorbed; it is probably reflex through the gastric filaments of the pneumogastric nerve. Recent observers assert that copious water drinking temporarily increases the water in the blood. Glax states that the ingestion of hot water causes a temporary increase in the flow of urine, but that systematic continued use leads to its diminished excretion, with a compensatory simultaneous increase of perspiration. All the secretions (bile, gastric and pancreatic juices, saliva, etc.) are increased by drinking hot water. The depurative effect of water, of great therapeutic value, is assisted by the presence of the mineral

ingredients, which allows large quantities to be taken (aërated waters); by obtaining the same result with a smaller dose (saline or aperient waters), or by furnishing some agent which chemically aids in removing a noxious substance from the body (alkaline waters to neutralize acids, or loosen mucus adhering to the gastric walls in catarrh).

Therapeutic Uses. — The internal use of thermal waters is beneficial in most of the ailments for which the waters are employed externally; especially is this true in gouty and rheumatic conditions. Inhaled as a fine, warm spray, they afford relief in acute bronchial catarrh of irritable character and with scanty secretion, in laryngeal and pharyngeal catarrh, and in the paroxysms of spasmodic cough.

The simple thermal waters, taken in large amounts, are useful in catarrhal conditions of the urinary organs, relieving irritation, assisting to dissolve concretions, and cleansing the passages.

In chronic lead or mercurial poisoning the use of the simple thermal waters is attended with benefit. Though the sulphur waters were formerly preferred, the simple thermals have been found quite as efficient.

Types: England: Buxton, Derbyshire (82° F.); France: Plombières (54°-156° F.), Dax (140° F.), Bagnères-de-Luchon (131° F.); Switzerland: Ragatz-Pfäfers (99° F.); Germany: Wiesbaden (155° F.), Baden-Baden (155° F.), Nauheim (98.5° F.), Wildbad, Wurtemberg (98° F.); Austria: Teplitz, Bohemia (82°-120° F.); Gastein, Salzburg (87°-160° F.); Italy: Bormio, Province of Valteline (105° F.); United States: California Geysers (150°-214° F.), Arkansas Hot Springs (76°-157° F.), Virginia Hot Springs (108° F.), North Carolina Hot Springs (96°-104° F.); Hunter Springs, Montana (148°-168° F.); Glenwood Springs, Colorado (124°-126° F.).

2. SULPHUR WATERS. — These waters were formerly accorded wonderful properties. An infinitesimally small quantity of sulphuretted hydrogen imparts a strong odor to these waters. Their position as a therapeutic agent has latterly been usurped by the indifferent thermals,

the latter being found equal in their cleansing and depurative powers. Sulphur waters may be warm or cold. The contents of sulphuretted hydrogen varies from a mere trace to about 42.6 c.c. per liter (Herculesbad, in Hungary).

Physiological Action.—Sulphur waters taken internally cause a tendency to constipation, the stool gradually darkening, and becoming even black. Prolonged use induces anemia. The biliary secretion is said to be increased, and hepatic congestion and enlargement decreased.

Therapeutic Uses. — Sulphur waters have great vogue in rheumatism and gout, especially in the subacute and chronic forms; the time when an acute attack subsides is considered the best to begin treatment. In chronic catarrhs (pharyngeal, laryngeal, gastric, etc.) and asthma sulphur waters are much used. A tendency to hemoptysis is regarded as a contraindication.

Syphilitic patients are sent for treatment to the various sulphur springs, but the benefit is undoubtedly due more to the effective mercurial treatment carried out by inunction at those springs than to the sulphur. Aix-la-Chapelle (Aachen), Aix-les-Bains, and the sulphur springs of the Pyrenees have long been popular resorts for syphilitics. Patients with skin diseases (chronic eczema, psoriasis, acne, etc.) are persistent patrons of these springs. In chronic catarrhal conditions, nervous affections, and uterine complaints benefit has, in some cases, followed the use of sulphur waters.

Types: England: Harrogate; Scotland: Strathpeffer; France: Barèges, Cauterets, St. Sauveur, Luchon, Aix-les-Bains; Germany: Aix-la-Chapelle (Aachen); Austria: Baden; Hungary: Mehadia, Ofen; United States: Ballston Spa, Sharon, Saratoga, White Sulphur (Va.), Blue Lick (Ky.), Minnequa (Pa.), Bladon (Fla.), St. Helena White Sulphur (Cal.).

II. STOMACHIC AND DIURETIC.

1. SIMPLE AËRATED OR TABLE WATERS.—Simple aërated waters, sometimes called acidulated or carbonated waters, contain from 300 to 1500 volumes of carbonic acid in 1000 volumes of water.

They may contain sodium and calcium bicarbonates and sodium chloride and sulphate. These waters are almost all cold and of pleasant taste and are, in some cases, further charged with carbonic acid before export. They are cold waters.

Physiological Action.—The physiological action of these carbonated waters appears to be due to the effect of the gas on the nerve-ends of the mucous membrane. The carbonic acid gas escaping from the water causes an agreeable prickling sensation in the mouth and gullet, while in the stomach a sensation of warmth and slight distention are felt. This distention and stimulation cause the stomach to contract and expel the gas by the mouth. The intestines are seldom affected unless they are in an irritable condition, when slight peristalsis is induced. The effect upon the nervous system is one of freshness and exhilaration, due to the reflex excitement of the nerve-centers through the stimulation of the nerve-endings of the tongue, palate, and stomach. The absorption of aerated waters is more rapid than that of plain water, and hence produces a more rapid flow of urine. Glax holds that aerated waters raise the blood tension, a general effect of drinking cold water.

Therapeutic Uses.—The aerated waters are useful in irritable conditions of the stomach; mixed with milk or alcohol, the latter are made tolerant to the stomach. Used as table waters, they stimulate the appetite, and, by causing a better mixing of the food and more active movements of the muscular coats, aid digestion. When the stomach is dilated and its walls flabby, the use of aerated waters is contraindicated.

The aerated waters are useful as a gargle in subacute pharyngitis. In pruritus, prurigo, and hyperæsthetic conditions of the skin carbonated waters are beneficial when used as baths.

Types: France: St. Galmier; Germany: Apollinaris; Austria: Giesshübler; United States: White Rock (Wis.).

2 and 3. **SIMPLE ALKALINE AND ALKALINE-SALINE WATERS.**—The alkaline waters contain sodium bicarbonate as their chief ingredient. They are nearly all cold; Neuenahr Sprudel, how-

ever, has a temperature of 104° F. (40° C.), and the Source de l'Hôpital, at Vichy, one of 87° F. (30.8° C.). Many are used as table waters.

Physiological Action.—The physiological action of these waters resembles that of the carbonated waters, as the sodium bicarbonate on reaching the stomach combines with the free acids and liberates carbonic acid.

Therapeutic Uses.—The alkaline waters are chiefly employed in the treatment of affections of the mucous membranes of the respiratory, digestive, and urinary tracts, but are also popular in chronic gout and rheumatism.

In chronic catarrh of the pharynx, nasopharynx, and larynx the sodium bicarbonate in the waters aids in the removal of the thick and tenacious mucous secretions, enabling other remedies to be more efficaciously applied. At the springs the waters are used in the form of warm sprays. In chronic gastric catarrh 1 or 2 glasses of water, taken on an empty stomach, loosens and washes away the mucus from the walls of the stomach, and prepares that organ for the next meal. The alkaline waters are useful for washing out a dilated stomach. They are commonly used in hepatic disorders and in suspected obstruction of the bile-ducts from catarrh or calculi.

Many diseases of the urinary tract are benefited by alkaline waters: Highly acid urine, uric acid concretions in kidney or bladder, and catarrh of the bladder or urethra.

Types of alkaline waters: England: Bristol, Buxton; France: Vichy, Mont Dore; Germany: Fachingen, Obersalzbrunnen, Ems, Wildungen; United States: Saratoga Vichy, Ukiah Vichy (Cal.), St. Louis Spring (Mich.), Manitou (Col.), California Seltzer, Bladon (Ala.), Gettysburg (Pa.).

Types of alkaline-saline waters: France: Royet, Vals (Desirée Sp.); Germany: Ems, Selters (Nassau); Austria: Luhatschowitz; United States: Ballston Spa (N. Y.), Hathorn (Saratoga), Waconda Spring (Kan.), Americanus Well (Mich.), Borland Mineral Well (W. Va.), Dixie Spring (Tenn.), Hot Springs (Va.), Bethesda (Wis.).

III. MILD INTESTINAL STIMULANTS.

1. SODIUM CHLORIDE WATERS.—

In these waters sodium chloride is the chief ingredient, but other salts are always present (calcium and magnesium chlorides, sodium bicarbonate and sulphate). Some of these waters are warm—Wiesbaden, 155.6° F. (68.7° C.); Baden-Baden, 155° F. (68.36° C.); Bourbonnelles Bains, 138° F. (58.75° C.); Burtscheid, near Aix-la-Chapelle, 140° to 165.2° F. (60° to 74° C.); Battaglia, in Italy, 159.8° F. (71° C.). These waters are mostly used in baths.

Physiological Action.—The physiological action of these waters is not definitely known; but the facility of diffusion of sodium chloride, the aid it lends the diffusion of albumin, and its attraction for water may throw some light on that point.

Therapeutic Uses.—In chronic catarrh of the stomach and bowels, where there is muscular atony or deficient secretion of gastric juice, these waters do well. These saline waters remove the altered secretions, preventing their fermentation and decomposition and thus indirectly favor the secretion of the gastric juice. In hepatic hyperemia and cirrhosis these waters aid by depleting the portal system, and are more potent when they contain sodium sulphate. Inhalation of these waters is beneficial in catarrhal affections of the air passages where there is an irritable condition of the mucous membrane and scanty secretion.

Types: Germany: Nauheim (Friedrich-Wilhelm's Quelle), Baden-Baden, Kreuznach (Oranien Quelle), Homburg (Elizabethbrunnen), Wiesbaden; England: Harrogate, Cheltenham; France: Bourbonne-les-Bains; Switzerland: Rheinfelden; United States: Glen Springs (N. Y.), Geuda (Kan.), Eureka (Cal.), Akesion Spring (Mo.), Byron Surprise (Cal.), Clark's Red Cross Mineral Well (Mich.), St. Clair Mineral Spring (Mich.).

2. ALKALINE APERIENT WATERS.

IV. STRONG APERIENT WATERS.

—The chief ingredients of the aperient waters are sodium sulphate, chloride, and bicarbonate, the most important of which is sodium sulphate. The stronger aper-

ients contain in addition magnesium sulphate.

Physiological Action.—The physiological action of these waters is largely due to the attraction of the sodium sulphate (Glauber's salt) for water, and to the difficulty with which they pass through membranes (osmosis). Hay found that the saline purgatives increase the intestinal secretions, not by osmosis, but by the irritant and specific qualities of the salt, and also probably by its bitterness. By reason of the low diffusibility of the salt, the fluid secreted into the intestine is not readily absorbed; the fluid accumulates, and, causing increased peristalsis, reaches the rectum, where it gives rise to purgation (Huggard). After some hours the salt causes diuresis, and with it a secondary concentration of the blood, which continues during the activity of the diuresis. An increased blood-pressure follows the ingestion of these waters.

Therapeutic Uses.—These waters are largely used in obesity, gastric and intestinal catarrhs, liver affections, gallstones, pelvic congestions, and old exudates. Gout, rheumatism, and arthritic affections are benefited when special indications are present, in robust subjects, for action upon the alimentary canal. The continued use of these waters causes irritation of the mucous membrane of the bowels. The duration of the "cure" with these waters is usually twenty-one days (Huggard).

Types: Austria: Marienbad, Carlsbad; Hungary: Apenta, Aesculap, Hunyadi János; Spain: Carabaña, Rubinat; Germany: Friedrichshall, Kissengen; Bohemia: Püllna, Seidlitz, Franz-Josephquelle; United States: Clark's Riverside Spring (Mich.), Castalian Springs (Cal.), Blue Lick (Mo.), Crab Orchard (Ky.), Gibson Mineral Well (Tex.), French Lick Pluto (Ind.), Harrodsburg (Ky.), Bedford (Pa.).

B. TONIC AND RECONSTITUENT.

I. HEMATOGENIC.

1. IRON WATERS.—The chief constituent of these waters is iron, which may be present in the form of the carbonate or the sulphate. The carbonate of iron waters are the more numerous and important, and usually contain free carbonic acid, which

covers the styptic taste of the iron and renders them more acceptable to the stomach. The sulphate of iron waters, as a rule, contain more iron, and some contain arsenic in appreciable amounts, Roncegno (Tyrol) water having $2\frac{1}{2}$ grains (0.15 Gm.) per quart (liter).

Physiological Action.—The physiological action of these waters is that of their principal ingredient, iron.

Therapeutic Uses.—These waters are useful in anemia and in conditions dependent upon anemia. Atonic dyspepsia, chronic diarrhea, hysteria, hypochondriasis, neuralgias, and neuroses dependent upon debility or anemia are much benefited by a course of these waters, especially when aided by the pure, bracing air and pleasant surroundings at the various spas. Menstrual irregularities and uterine catarrhs are special features of the iron spas, great relief following the use of the waters.

Types: England: Brighton, Harrogate, Tunbridge Wells; Switzerland: St. Moritz (Grand Source); Belgium: Spa (Pouhon-Liège); Germany: Schwalbach (Stahlbrunnen), Homburg (Stahlbrunnen), Pyrmont (Trinkbrunnen); Bohemia: Marienbad, Franzensbad; Austria: Levico; United States: Matchless Mineral Wells (Ala.), Overall Wells No. 2 (Tex.), Brown's Wells No. 1 (Miss.), Gaylord and Gulick's Spring (Va.), Oak Orchard (N. Y.), Bath Alum (Va.), Anderson's Spring (Pa.), Rawley Springs (Va.), Cooper's Well (Miss.), Ballston Spa (N. Y.).

2. EARTHY OR LIME WATERS.—The chief ingredient of these waters is lime in the form of the bicarbonate or the inert sulphate, and a small quantity of magnesium bicarbonate and other salts. By many authorities they have been considered harmful, while others point to the presence of lime in the tissues and secretions and assert that a certain supply is requisite to replace loss through tissue change. When lime is given for therapeutic purposes the soluble and readily absorbable preparations (chloride or acid phosphate) are preferable (Huggard).

Therapeutic Uses.—These waters have been employed in pulmonary affections (including tuberculosis and rachitis), in urinary affections (catarrh of the bladder,

kidney, and gravel), in affections of the stomach and intestines, in biliary affections, in gout, rheumatism, and diabetes, and in skin affections (chronic dry eczema and psoriasis in lymphatic or scrofulous subjects).

The administration of lime to old persons with atheromatous tendencies is considered undesirable.

Types: A. Carbonate of lime waters: France: Châtel Guyon, Pougues; Germany: Rippoldsau, Driburg, Wildungen. —B. Sulphate of lime waters: England: Bath (Somerset); France: Vittel (Vosges), Contrexéville (Vosges); Switzerland: Leuk, Baden, Weissenburg; Germany: Lippspringe.

II. ALTERATIVE AND NERVINE.

1. ARSENICAL WATERS.—These waters contain a therapeutically significant amount of arsenic, although usually named after some other constituent. Vichy water, known as an alkaline water, contains $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001 to 0.002 Gm.) of arsenic trioxide per quart (liter). The water of Bussang (Vosges), known as a simple, aerated water, contains $\frac{1}{30}$ grain (0.002 Gm.) of arsenic per quart (liter). La Bourboule (France), the strongest of the alkaline arsenical waters, contains $\frac{1}{2}$ grain (0.028 Gm.) of sodium arsenite per quart (liter). Strong Levico water (Tyrol) contains $\frac{1}{4}$ grain (0.0087 Gm.) and Roncegno (Tyrol) contains $2\frac{1}{3}$ grains (0.15 Gm.) per quart (liter). The arsenical content must be borne in mind in using these waters.

Therapeutic Uses.—These waters have been employed in dyspeptic troubles due to gastric irritability, gastric catarrh, nervous indigestion and hyperacidity, and as a nerve sedative in asthma and chorea. While pharmacopoeial preparations are best, these waters may be used in chronic malaria, and if an alkaline water is indicated an arsenical water may be used. The same is true in the treatment of skin diseases.

2. BARIUM CHLORIDE WATERS.—Barium chloride exists in minute quantities in many mineral waters. The Elisabethquelle at Kreuznach contains 1 grain (0.064 Gm.) per quart (liter), the Victoriaquelle nearly $1\frac{1}{2}$ grains (0.089 Gm.) per quart (liter), and the Llangammarch Spa

TABLE SHOWING COMPARATIVE POTENCY OF REPRESENTATIVE AMERICAN AND EUROPEAN SPRINGS (JAMES K. CROOK).*

I. ALKALINE WATERS.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
Saratoga Vichy	367.32	Vichy, France (Grand Grille)	311.92
Ukiah Vichy, Calif.	268.45	Fachingen, Nassau, Ger.	223.51
St. Louis Spring, Mich.	227.14	Ems (Kessel Brönnen)	169.75
Manistow, Colo. (Navajo)	182.23	Apollinaris, Rhenish Prus.	157.76
California Seltzer	187.15	Wellbach, Hesse, Ger.	165.27
		Wildungen, Ger. (Stadt-Brönnen)	67.44

II. ALKALINE SALINE.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
Ballston Spa, N. Y. (artesian lithia)	1123.25	Vals, France (Desirée Sp.)	535.88
Waconda Spring, Kan.	1120.65	Bourbonne (Haute Marne, Fr.)	483.47
Saratoga, N. Y., Hathorn	888.40	Luhatschowitz, Moravia	438.04
Americanus Well, Mich.	503.90	Billn, Bohemia (Joseph's Quelle)	304.49
Borland Mineral Well, W. Va.	432.28	Selters, Nassau, Ger.	228.14
Dixie Spring, Tenn.	313.74	Obersalz-Brönnen, Silesia	138.08

III. MURIATED SALINE.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
Glen Springs, N. Y. (Neptune, used for Schott-Nauheim treatment)	10503.08	Springs of Nauheim, Ger. (Friedrich- Wilhelm's Quelle)	2148.07
Geuda Springs, Kan.	1314.78	Kreuznach (Oranien Quelle)	1084.32
Eureka Springs, Calif.	1800.27	Homburg, Ger. (Elizabeth Brönnen)	870.96
Sweet Springs, Mo. (Akeson Sp.)	1061.94	Harrogate, Eng.	864.43
Lodi Artesian Well, Ind.	672.45	Cheltenham, Eng.	644.00
Upper Blue Lick, Ky.	660.14	Wiesbaden, Ger. (Koch-Brönnen)	507.70

The strongest waters of this class on the globe are found in the United States. Notable examples are the Byron "Surprise" Spring of California, containing 18,773.73 grains; Clark's Red Cross Mineral Well of Michigan, 17,825.27 grains, and the St. Clair Mineral Spring of Michigan, 17,904.6 grains per U. S. gallon.

IV. SULPHATED SALINE.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
Clark's Riverside Springs, Mich.	7318.97	Carabafia, Spain	7391.23
Castalian Springs, Calif.	4422.25	Rubinat (Serre), Spain	5266.64
Blue Lick Springs, Mo.	610.30	Apenta, Hungary	2541.09
Crab Orchard, Ky. (Epsom Sp.)	401.43	Püllna, Bohemia	2010.45
Gibson Mineral Well, Texas	329.65	Friedrichs-Hall, Ger.	1559.92
French Lick Springs, Ind.	371.76	Seidlitz, Bohemia	897.59

V. CHALYBEATE.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
Matchless Mineral Wells, Ala.	167.91	Brighton, Eng.	14.40
Overall Wells, Tex., No. 2	144.90	Spa (Pouhon), Liège, Belgium	5.42
Brown's Wells, Miss., No. 1	36.52	Schwalbach Nassau, Ger. (Stahlbrönnen). ..	3.74
Gaylord & Gulick's Springs, Va.	31.63	Tunbridge Wells, Eng.	2.22
Oak Orchard, N. Y.	28.62	Pyrmont, Waldeck, Ger. (Trunk-Brönnen) ..	2.48
Bath Alum, Va.	26.78	St. Moritz (Grand Source), Switzerland .	1.38

The figures refer to the amounts of ferruginous salts per U. S. gallon. The U. S. possesses innumerable chalybeates of the milder grades.

VI. THERMAL WATERS.

AMERICA.	Gm. per U. S. gal.	EUROPE.	Gm. per U. S. gal.
California Geysers	150°-214° F.	Wiesbaden, Ger. (Koch-Brönnen)	155° F.
Hunter Springs, Mont.	148°-168° F.	Baden-Baden, Ger. (Haupt-Quelle)	155° F.
Arkansas Hot Springs	76°-157° F.	Gastein, Salzburg, Austria	87°-160° F.
Glenwood Springs, Col.	124°-126° F.	Bagnères-de-Luchon, France	131° F.
Virginia Hot Springs (boller)	108° F.	Nauheim, Ger.	98.5° F.
North Carolina Hot Springs	96°-104° F.	Wildbad, Ger.	98° F.

Some of the undeveloped thermals of the Rocky Mountain States and California issue from the earth at a boiling temperature.

* Tabulated in accordance with author's classification in "The Mineral Waters of the United States," Philadelphia and New York, 1899, and in Hare's "System of Practical Therapeutics," 1901.

(Wales) nearly $1\frac{1}{2}$ grains (0.09 Gm.) per quart (liter).

Therapeutic Uses. — The waters of Llangammarch have been employed in cardiac cases, but it is only fair to say that they are used in connection with carbonic acid baths of the Nauheim type and other treatment.

In concluding the consideration of mineral springs, we quote James K. Crook, of New York, who says: "Not merely in potency of a few individual springs, but in general variety of mineral ingredients and in all the elements which go to make up an attractive analysis and a useful medicinal water, we have within our own borders (United States), with the single exception of the sulphated salines (Hunyadi János, Carabaña, Apenta, Rubinat), better waters and more of them than are shown by any European work on this subject." A comparative table of European and American waters is appended.

[A commission has been appointed by the State of New York to erect at the Saratoga Springs a large bath house with administration building and power house and a central drink hall, to which will be conducted all the available drinking waters in the village proper and in the geyser district, so that the invalid and the luxurious will not be obliged to go to the source of the various springs whose waters are prescribed for them. The central drink hall, moreover, will permit of the service of drinking waters, either hot, warm, or cold, as prescribed by the physician, and will tend to obtain obedience to the physician's order to drink the water slowly while promenading about the pavilions or in the park. Some of the baths will be of low cost for those of moderate means, others sumptuous for those of means, and free baths for those unable to pay, while free service of drinking waters at their source will be maintained by the State.

There would seem to be little necessity, at the present time, for the sending of patients abroad to receive the benefits of spa treatment, especially when we consider the proximity and accessibility of our home resorts, the complete equipment for serving drinking waters, for giving the various baths, and the facilities furnished at many of our resorts for the various

methods of auxiliary treatment (Schott, Oertel, Nauheim, Carlsbad, and other forms of hydrotherapy, radium emanatoria, Zander inhalatoria, etc.). W.]

CLIMATOLOGY AND CLIMATOTHERAPY.

CLIMATOLOGY. — According to A. N. Bell, climatology comprises "the sum of the influences exerted upon the atmosphere by temperature, humidity, pressure, soil, proximity to the sea, lakes, rivers, plains, forests, mountains, light, ozone, electrical, and, doubtless, by some other conditions of which we have no knowledge" beyond observation of their effects. Hann and Humboldt define climate as comprising the whole of the meteorological phenomena characterizing the state of the atmosphere at any place, particularly as they affect our organs, or have influence on vegetable or animal life. The good effects of the most salubrious climate may be overcome and the development of disease invited by the neglect of proper sanitary measures and the violation of physiological laws. It is difficult to classify climates; the distinctions made are often relative or conventional. Hot and cold climates, dry and humid climates, inland and marine climates convey only a general idea.

CLIMATOTHERAPY. — Climatology studies the effects of climates and climatic conditions upon health. To mental or moral conditions or to psychological effects must be ascribed the benefits of a change of climate in disease frequently be ascribed. To deprive semihelpless invalids of the home and creature comforts that they are accustomed to enjoy and add the effects of homesickness to those of their physical weakness and disease are unwarranted cruelties. The individual peculiarities of each locality must be considered, such as dryness or dampness of the soil, excess of sunshine or shade, the direction and character of the prevailing winds, the presence and character of forest trees and bodies of water, convenience of access, as well as comfortable hotel accommodations, pure drinking water, good milk and other food in abundance, and the sanitary conditions.

The United States, in its wide area, offers every variety of climate. At the seashore

or on islands some distance from the coast, an ocean climate may be enjoyed. Numerous popular resorts are*to be found on the Appalachian or Rocky Mountain ranges.

The salubrity of the high tablelands of New Mexico and Arizona is acknowledged, while the valleys of California, between the foothills and the coast range of mountains, are noted for their beauty and health-giving powers. There are the cold climates of Maine and Minnesota and the hot ones of the Eastern Atlantic Coast in the Southern States, and a new-world Riviera exists along the gulf coast of Florida, especially undulating countries around Tarpon Springs and the Pinellas peninsula.

A helpful classification of climates is that offered by Hermann Weber, slightly modified, as follows:—

A. Marine Climates.

I. Marine Climates with High Degree of Humidity.

1. Warm and Moist Marine Climates:—

Madeira, Canary Islands, The Azores, Ceylon, Sandwich Islands, Bahamas, Bermudas, Virgin Islands, Cuba, Jamaica, Barbadoes, Society Islands, Tahiti, Tonga, Fiji Islands, Tristan d'Acunha, St. Helena, Florida, Georgia, South Carolina.

2. Cool and Moist Marine Climates:—

Island of Bute, Rothesay, Hebrides, Orkney and Shetland Islands, Faroë Islands, Iceland, Bergen, Marstrand, Auckland Islands, Falkland Islands.

II. Marine Climates with Medium Degree of Humidity.

1. Warm Marine Climates of Medium Humidity:—

Tangiers, Algiers, Cadiz, San Lucar, Gibraltar, Ajaccio, The Sanguinaires, Palermo, Riviera di Levante, Pegli, Venice, Balkan Peninsula, Corfu, Crimea, Lisbon, Vigo, Santander, Biarritz, New Zealand, Auckland, New Plymouth, Wellington, Nelson, Virginia Beach, Old Point Comfort, San Diego, Coronado Beach.

2. Cool Marine Climates of Medium Humidity:—

English and Irish Coasts, Newport, Isle of Shoals, Nantucket, Mount Desert, Fire Island.

(a) Winter resorts: Queenstown, Isle of Wight, Florida; Lakewood, N. J.; Santa Barbara, Cal.

(b) Summer resorts: North Coast of Cornwall and Devonshire, Wales, Ireland, Brest, North Coast of France, Belgium, Holland, Germany, Tasmania; Santa Barbara, Cal.; Monterey, Cal.

III. Marine Climates with Low Degree of Humidity.

The Western Riviera, Nice, Monte Carlo, Mentoné, Naples, Capri, Ischia, Malta, The Balearic Islands, Smyrna, Athens, South Africa, Australia, New South Wales, Sydney, Victoria, Melbourne, The New Jersey Coast, Long Branch, Beach Haven, Atlantic City, Cape May.

B. Inland Climates.

I. Climates of Great Altitude, or Mountain Climates.

Davos-Platz, Davos-Dörfl, Davos-Frauenkirch Wiesen, St. Moritz, European Alpine Resorts, German Mountain Resorts, Northern Italy, Apennines and Maritime Alps, Peruvian Andes, South Africa, India, Mexico, Rocky Mountains, Colorado Springs, Denver, St. Paul, Asheville, Catskills, Adirondacks, Alleghenies, Cresson, Green Mountains, White Mountains, Glen Summit, Pocono, Kane, Schooley's Mountain, Pasadena, Cal., etc.

II. Climates of Low Levels.

Dry and Warm Climates: Africa, New Mexico, California.

Dry and Cold Climates: Minnesota, Canada.

Moderately Moist Climates: Rome, Pisa, Pau, New England States, Saratoga, Los Angeles, etc.

CHOICE OF CLIMATE IN DISEASE.

—Into the solution of this problem enter the psychical and physical condition of the patient, his finances, his ability to en-

dures the discomforts of travel, his personal preferences and habits, the nature of his disease, and the advantages and physiological effects of the proposed location. Patients with seriously impaired lungs, kidneys, or heart should not be sent to places of great altitude. Patients with exhausted vitality or evidently with a short time to live should not be sent to any great distance from home. Scenery or the incidents of travel do not interest a very sick patient; homesickness may prove mortal sooner than his disease. Moist or dusty climates, whether cool or warm, are not suitable for phthisical cases in the second or third stage; in them the progress of the disease is generally hastened.

Acute diseases are best treated at home. **Anemia** and **chlorosis** are benefited by open-air life, sunshine, and a temperature that does not forbid exercise. **Asthmatics** without heart complication or emphysema do well at mountain stations or on inland plateaus; if there is serious bronchial complication a dry climate is indicated; where the secretion is scanty, the pine woods near the coast are best. **Hyperesthetic rhinitis** patients need pure air, free from dust and pollen, as found at Bethlehem, White Mountains, Kane, or Nantucket. **Chronic bronchial catarrh**, with increased secretion and moderate cough, may be relieved at seashore, mountain, or inland resorts, the change of climate itself being beneficial. Menorrhagia is often made worse by sea climates; in early pregnancy abortion may occur at the seashore. **Climacteric disorders** are relieved by climatic change, the excitement of the change of scene, and the pleasures and incidents of travel. **Premature senility** is often delayed by a resort to warm, sunny and dry climates during the winter and a moderately elevated mountain climate in summer. **Phthisis**, according to Flint, requires dryness, equability, and purity of the atmosphere; he further states that there is reason to believe that the benefit derived from climatic treatment is often, in a great measure, due to accessory circumstances. A climate favorable to open-air life is desirable, as in New Mexico. Flint suggested that if hot weather improved the patient and cold weather made him worse,

he should go south, at least in the winter; if he is always better in cold weather, a northern resort, as Denver, Colorado Springs, St. Paul, etc., is desirable. Other specially famed lung resorts are the Adirondacks, Lakewood (N. J.), Asheville (N. C.).

Neurasthenia and **exhaustion from overwork, hypochondriasis, and hysteria** are benefited by combined balneotherapeutic and climatic treatment. Cases of **indigestion, dyspepsia, and chronic diarrhea** do best in a dry, equable climate. **Insomnia** is relieved by a sojourn at mountain or seashore resorts, but the locality must be one where there is freedom from noise and excitement. **Leukemia** is benefited by ocean voyages, long cruises in yachts, and by prolonged stay in Egypt and Algiers. In **malarial toxemia** mountainous regions afford a cure; while sea voyages are beneficial, damp localities are to be avoided on land. W.

MITRAL INCOMPETENCY.

See ENDOCARDIUM AND VALVES, DISEASES OF.

MITRAL STENOSIS. See ENDOCARDIUM AND VALVES, DISEASES OF.

MOLLUSCUM CONTAGIOSUM.—**DEFINITION.**—This affection, known also as molluscum epitheliale and molluscum sebaceum, is characterized by the formation of sessile or pedunculated, smooth, semiglobular tumors varying in size from a pinhead to a marble.

SYMPTOMS.—The lesions are discrete, yellowish white or pinkish in color, rounded or acuminate, imbedded within or projecting beyond the surface of the skin, and have usually a dark-colored point at the apex, from which, on pressure, can be expressed a milky, curd-like, or cheesy substance. At first the lesions are quite firm, but they soften with age. After persisting for several weeks, they slough and disintegrate, or undergo slow absorption. The tumors give rise to no pain, are always discrete, may be single or multiple, and occur usually in children or young adults upon the eyelids, face, neck, breast, and genitals. This dis-

ease frequently affects several members of the same household, asylum, or school.

DIAGNOSIS.—The color, the wax-like appearance, the umbilication, and the central aperture are the diagnostic features. From molluscum fibrosum it is distinguished by the absence of the central black opening in the latter and the more general distribution.

ETIOLOGY AND PATHOLOGY.—The disease is probably contagious, though under ordinary circumstances feebly so, and it is said to be due to a parasitic protozoön of the coccidium type.

Various authors claim to have discovered protozoa within the cells of the tumors. Herzog finds, however, that these peculiar structures are solely due to hyaline degeneration, and by a special stain he could accurately study the evolution of the so-called "molluscum bodies" from the normal basal epithelium. An interesting discovery which may explain the infectious nature of the disease is the finding of large numbers of staphylococci in the excretory ducts and the surrounding tissues.

In cases in which the central pore or depression was obvious Kreibach has found spirochetes of the *refringens* type. His observations were confined to genital cases, and he believes the infection to be a secondary one, as they were not found in those lesions in which a central depression had not developed.

PROGNOSIS.—The prognosis is favorable, though the disease may persist for months or even years. It yields readily to treatment.

TREATMENT.—Thorough inunctions with **white precipitate or sulphur ointment** (20 to 40 grains to the ounce) are efficacious in some instances; when they are not, each tumor should be **incised**, its contents removed, and the remaining cavity cauterized with **silver nitrate, phenol, or tincture of iodine**. Raven has used **sodium ethylate** in an extensive case of molluscum contagiosum. A single application sufficed to remove most of the tumors. Pedunculated lesions may be removed with scissors, silver nitrate being then applied to their bases. General tonics (**iron, arsenic, and strychnine**) are often indicated.

W.

MONOBROMATED CAMPHOR. See CAMPHOR.

MORBILLI. See MEASLES.

MORPHEA. See SCLERODERMA.

MORPHINE AND MORPHINISM. See OPIUM.

MORVAN'S DISEASE. See SPINAL CORD, DISEASES OF.

MOUNTAIN ANEMIA. See PARASITES, DISEASES DUE TO.

MOUNTAIN FEVER. See MALARIAL FEVER.

MOUNTAIN SICKNESS. See RAREFIED AIR, DISEASES DUE TO.

MOUTH, LIPS, AND JAWS, DISEASES OF THE.
CATARRHAL STOMATITIS.

DEFINITION.—An acute inflammation of the mucous membrane of the mouth, usually caused by local irritation or occurring in the course of exanthematous diseases or prolonged febrile disorders.

SYMPTOMS.—Although the entire buccal membrane may be involved,—that of the tongue, lips, and cheeks,—the labiogingival region is usually the seat of the most active inflammatory manifestations. Redness, heat, tumefaction, furring of the tongue, and local discomfort constitute the symptoms witnessed in light cases; but in some, and particularly in infants, there is severe pain, sufficient, indeed, in the majority of cases to prevent nursing. Craving for cold drinks and perverted taste are nearly always noted. Local pain also attends a form of stomatitis observed in nursing women. In severe cases of catarrhal stomatitis the tongue appears enlarged and the lingual papillæ project prominently. The saliva is

greatly increased in quantity and is often sufficiently acrid to excoriate the lips and chin. Minute areas of the epithelial covering often become transformed into small, shallow, pul-taceous, and quite painful ulcers, which are especially sensitive when touched or brought into contact with other mucous surfaces during mas-tication. An alkaline reaction of the saliva is usual during the ulcerative stage. Slight fever is sometimes present even in the condition occurring independently of infectious febrile disorders, of which catarrhal stomatitis is a frequent complication. The symptoms usually last from four to ten days.

The general condition is rarely disturbed except when the stomatitis is secondary to inflammations in other parts of the alimentary tract or to the specific infectious fevers.

In some instances the oral mucous membrane is dry, the inflammation manifesting itself by the presence of heat, pain, and redness. This constitutes the "erythematous catarrhal stomatitis" of certain authors.

ETIOLOGY AND PATHOLOGY.

—Catarrhal stomatitis may be primary or secondary. In the primary form the causative factor is a local irritant, —mechanical, chemical, or thermal,—which gives rise to excessive des-quamation of the epithelium. Undue acidity of the oral secretions, unduly hot or cold foods, tobacco, strong condiments, fermenting or decomposing particles of food through insuffi-cient cleansing of the mouth and teeth, dental caries, etc., may give rise to the affection. In the secondary form the oral inflammation is symp-tomatic and often attends infectious diseases,—measles, typhoid fever,—

and other exanthemata, and the pro-longed fevers. It may also arise through continuity of tissue or by in-fection, owing to the presence in neighboring structures of an acute in-flammatory disorder, such as ton-sillitis, gingivitis, pyorrhea alveolaris, etc. Gastric disorders are frequently complicated with catarrhal stomatitis. This oral disease may also occur as an evidence of general depravity of the organism the result of unhygienic surroundings and poor food.

In the true catarrhal form thicken-ing and softening of the mucous membrane is the most evident path-ological feature, epithelial erosions covered with pultaceous masses of cells undergoing retrograde meta-morphosis being observed in various spots in marked cases. Leucocytes and red blood-cells are sometimes present and usually *Leptothrix buc-cal*is, micrococci, and bacilli are also to be found. The saliva is usually acid in reaction.

TREATMENT.—After proper hy-gienic conditions have been estab-lished and all irritant influences re-moved, the treatment should be mainly local. The internal adminis-tration of **potassium chlorate**, fre-quently resorted to, is a pernicious practice in this form of stomatitis, owing to its evil influence upon the kidneys. Employed in saturated solution (about 1 dram—4 Gm.—to the pint—500 c.c.) as a mouth-wash, however, it is exceedingly use-ful. In many cases **sodium borate**, 10 grains (0.6 Gm.) to the ounce (30 c.c.), is more effective, employed frequently during the day, every half-hour, and with especial care after eating. In infants the mouth should be gently cleansed after each feeding

and a preparation of **boric acid**, 15 grains (1 Gm.) to the ounce (30 c.c.) of rose-water, applied with a swab, or, better, on a square piece of soft linen over the finger of the nurse. When cold drinks are ungrateful and the inflammation intense and protracted, the use of **hot milk** and **lime-water**, **mucilaginous decoctions**, and **sedative sprays** of 1 or 2 per cent. solutions of **cocaine** or **phenol**, or astringent solutions of **silver nitrate** ($\frac{1}{4}$ to 1 per cent.), **alum** (5 to 10 grains to the ounce of honey), or **glycerite of tannin** (2 drams—8 Gm.—to the ounce—30 c.c.—of water), are useful, especially where there is a tendency to chronicity. When mastication is difficult or very painful, the local application of a 4 per cent. solution of **cocaine** to the sensitive spots, affords great relief and enables the patient to eat comfortably. When the shallow ulcers resist less active measures they should be lightly touched with **copper sulphate** or a weak solution of some one of the **silver salts**, preferably the **nitrate**.

Tender or spongy gums are greatly benefited by the use of a mixture in equal parts of the **tinctures of myrrh** and **krameria**, applied with a camel's-hair brush.

As emphasized by L. Emmett Holt, perfect cleanliness of the mouth and nipples is of the utmost importance. The mouth should be cleansed after each feeding with cotton wrapped upon a small rod, or by inducing the child to suck **ice-water** from a piece of soft linen. **Food**, as far as possible, should be given **cold**, but the child should not be taken from the breast. If the disease persists, the mouth should be penciled with a $\frac{1}{2}$ per cent. solution of **silver nitrate** daily, and

cracks or ulcerations touched with the mitigated stick.

Internally, small doses of **aconite** or **potassium citrate** for the pyrexia, with minimum doses of **bromides** for the irritability and sleeplessness, may be required. An associated gastrointestinal catarrh may need correction through the use of **laxatives** and the administration of **bland foods**. Mild **tonics** should be used during convalescence.

APHTHOUS STOMATITIS.

SYMPTOMS.—In this variety of stomatitis there appear, besides the more or less marked inflammation of the oral mucosa, small, elevated, round or oval vesicles 2 to 5 mm. wide, and surrounded by a red areola, which, as early as twenty-four hours after their appearance, form shallow, yellowish-white spots of ulceration, with bright-red margins. They may appear singly or in groups in any part of the mouth, but they are apt to appear in greatest number on the labial mucous membrane, along the external portion of the gums, inside the cheeks, and along the edges of the tongue. The aphthæ may become confluent and give rise to large, irregular ulcers, the *confluent form* of stomatitis aphthosa. They are much more painful than those observed in the catarrhal form, and render nursing or the taking of food very difficult. The aphthæ sometimes extend to the fauces.

The general symptoms are somewhat more marked than in the previous form. Slight fever, anorexia, furring of the tongue, and heavy breath represent, however, about all the manifestations usually witnessed. Although there is an increased flow of saliva, the latter is never fetid

(Holt). The pain attending the presence of the ulcers renders the child especially cross and fretful when food is taken, but the active nervous manifestations of the more severe forms are absent. In the form observed in connection with febrile diseases the general symptoms are obviously those of the causative affection. Aphthous stomatitis tends to recur when the primary general cause is not completely removed.

ETIOLOGY AND PATHOLOGY.

—Aphthous stomatitis is usually observed in children under 3 to 6 years old, but is not rare in adults. It is a frequent complication of gastrointestinal disorders and is often seen in debilitated or poorly fed subjects, in tuberculosis, in anemia, and during dentition. It is most frequently met with in conjunction with, or as a sequel of, some febrile diseases, especially the acute exanthemata.

Local outbreaks of aphthous stomatitis have been traced to milk of cattle infected with foot-and-mouth disease (Ollivier), but the claim of Siegel that the cause of the disease in man and the lower animals is the same has not as yet been accepted.

No parasite special to the affection has as yet been isolated.

TREATMENT.—The treatment of this condition does not differ from that previously described. Proper hygiene, absolute cleanliness of the mouth, and the use of bland foods are important. Holt states that each ulceration may be touched with **silver nitrate**, but that no other active measures should be employed. The disease tends to spontaneous recovery in from seven to fourteen days. Goppert has recommended **orthoform** as a local anesthetic, the powder being

simply blown over the diseased areas, after cleansing the whole oral cavity. Food may be taken not sooner than 15 minutes after each application. Marfan resorts to frequent washing of the mouth with a saturated **boric acid** solution or a 1 : 500 solution of **phenol**. To the ulcers he applies a 5 per cent. solution of **silver nitrate**, a 1 : 500 solution of **potassium permanganate**, or a solution of **iodine** and **potassium iodide** in glycerin and water.

The following preparation is much employed by French clinicians:—

<i>R. Sodium borate</i>	4 parts.
<i>Tincture of benzoin</i>	2 parts.
<i>Distilled water</i>	10 parts.
<i>Syrup</i>	20 parts.

M. To be applied five or six times a day.

Swab applications of 4 per cent. **cocaine** solution may be necessary when the pain is very intense. In the confluent form **sodium salicylate** solution—1 dram (4 Gm.) to the ounce (30 c.c.) of water—used locally is recommended, and **potassium chlorate** in small doses in solution, as well as in the dry powdered form applied to the ulcers, is beneficial. Symptomatic treatment should be instituted as required.

ULCERATIVE STOMATITIS (FETID STOMATITIS; PUTRID SORE MOUTH).

DEFINITION.—Inflammation of the mucous membrane of the mouth and underlying structures, attended by the formation of a deep ulcer which usually develops in the gum about the lower incisors. It only occurs when there are teeth (Forchheimer).

SYMPTOMS.—Ulcerative stomatitis generally develops near the edge of the gum immediately above the labiogingival sulcus. The area af-

fectured is at first red and tumefied and very sensitive. A deep, pus-secreting ulcer having a red areola, surrounded, in turn, by a zone of edema, is soon developed. In some cases this ulcer reaches down to the periosteum, and is followed by necrosis of the alveolar process. The gingival mucous membrane becomes softened and spongy and the teeth are loosened. Although the inflammatory process may invade all the tissues of the mouth, the ulceration rarely extends beyond the anterior portion of the gums. Occasionally the membrane of the cheek opposite the ulcerated area also ulcerates. The breath becomes intensely foul, and slight gingival hemorrhages cause the profuse saliva secreted to appear bloody. Severe pain is experienced during mastication. There are swelling and pitting of the tongue and enlargement of the submaxillary glands. Vomiting, diarrhea, and marked fever are usually present, and an exanthematous eruption resembling that of measles is occasionally observed. In children the disease sometimes culminates fatally, especially when unhygienic environments and unwholesome food cannot be replaced by improved conditions, the disease being one denoting a depraved state of the general organism.

ETIOLOGY AND PATHOLOGY.

—That a specific micro-organism must exist is emphasized by the occasional prevalence of ulcerative stomatitis as an epidemic disease in institutions, barracks, camps, and prisons, especially when the sanitary conditions are defective and where poor food is supplied. Squalor in all its forms tends to promote its appearance, cold, damp, and defective ventilation being among the many pre-

disposing elements. Insufficient care of the mouth, especially when tartar is allowed to accumulate around the teeth, carious teeth or decaying roots, infectious diseases, congenital heart affections (Duckworth), scurvy, saturation of the system with lead or phosphorus are among the most frequent etiological factors known.

In a series of 30 cases examined by Bernheim and Popischill 2 micro-organisms were found in the ulcers in all the cases, a bacillus and a spirocheta (both motile). Besides these organisms, which were always present, there were usually also streptococci and staphylococci in addition to the organisms generally found in carious teeth, *Leptothrix buccalis*. The specific organism of ulcerative stomatitis may still be considered as unknown, however.

TREATMENT.—In this affection **potassium chlorate** may be given internally, 2 to 5 grains (0.12 to 0.3 Gm.) three times a day to a child, and also applied locally in the form of a mouth-wash, the saturated solution being employed. This constitutes a truly specific treatment, the disease being thus readily controlled.

Internally, it is best administered in a 3 per cent. solution with a little syrup, $\frac{1}{2}$ to 1 teaspoonful being given every two hours. Its toxic effects, if used in too large quantities, should not be forgotten. It usually produces considerable pain, but this soon ceases, and is a positive index of the curative effect of the drug. In obstinate cases the application of a solution of **silver nitrate** may be useful.

A 1 grain to the ounce solution of **potassium permanganate** is sometimes required to counteract the foul breath, and the nitrate of silver stick

applied to the edges of the ulcers hastens recovery. **Hydrogen dioxide**, 1 dram (4 c.c.) to the ounce (30 c.c.), is preferred by some clinicians as a mouth-wash. Kissel's procedure in obstinate cases is to **curette** the ulcers daily and rub into them powdered **iodoform**. Care should be taken to preserve teeth that are loosened by special attention to the surrounding gums; the latter should, besides being kept scrupulously clean, be occasionally painted with a 20-grain (1.3 Gm.) to the ounce (30 c.c.) solution of **alum**. Pieces of necrosed bone occasionally keep up the ulcerative process. The cavity from which the pus oozes should be carefully probed and surgical removal resorted to if needed. A **tonic** treatment should be instituted. The **syrup of iodide of iron** is especially valuable; **codliver oil** is preferable in poorly nourished children. **Hygienic surroundings** and **wholesome food** should be insured. The disease is contagious and proper **isolation** methods should be put in practice.

PARASITIC STOMATITIS (STOMATITIS MYCOSA; THRUSH; SPRUE; MUGUET; SOOR).

DEFINITION.—A disease characterized by the formation upon the mucous membrane of the mouth of pearly-white spots or flakes which gradually increase in size and spread to adjoining structures and organs.

SYMPTOMS.—This form of stomatitis usually begins upon the tongue, and, spreading in every direction, may gradually involve the lips, the cheeks, the palate, the gums, the tonsils, the pharynx, the larynx, and even the gastrointestinal tract down to the ileocecal valve (Parrot). The

superficial lesion appears as small, grayish-white spots, surrounded by a zone of blood-vessels. These soon become elevated, increase in size, and often coalesce to form a false membrane; this, in some instances, has a characteristic filmy, or lace-like, look; in others it stimulates a thick, friable pseudomembrane (Holt). These areas or flakes may be readily brushed off, leaving no appreciable mark upon the surface from which they were removed. Sometimes the flakes appear yellowish or brown, and the seat of implantation bleeds, shallow erosions being then perceptible. The constitutional symptoms are less marked than in the other forms. The local manifestations are comparatively benign. Indeed, dryness of the mouth and local heat, difficult nursing or feeding owing to more or less great tumefaction and stiffness of the mucous structures, represent about all the discomfort complained of. Still, the disease is a stubborn one and the lesions may persist for months. A fatal issue is occasionally witnessed in debilitated children.

ETIOLOGY AND PATHOLOGY.—The primary factors in the development of parasitic stomatitis consist of an abnormal condition of the oral mucous membrane, upon which is superimposed the influence of the *Saccharomyces albicans*. This fungus develops from round or oval spores into long, branching mycelial filaments requiring an acid medium and at no time growing upon the normal mucosa. Such a condition may be especially brought about in infants by unclean feeding-bottles when impaired general nutrition coexists. Sweets, fermenting bits of acid food, and uncleanliness of the mouth may act as

exciting causes by acidifying the normal secretions: a condition which the growth of mycelium intensifies. The transmission of the thrush spores by means of feeding-utensils, spoons, cups, feeding-bottles, etc., accounts for the epidemics occasionally observed.

The predisposing factors are mainly those which tend to lower the general vital tone: the exanthemata, hereditary syphilis, etc.; but it may also appear in apparently robust children. Parasitic stomatitis is likewise met with, in adults, as a complication or sequel of infectious fevers and diathetic diseases—cancer, tuberculosis, etc.

The fungus develops among the epithelial cells and acini of the mucosa, forming a dense network. It may be readily recognized microscopically if the diagnosis be at all doubtful.

TREATMENT. — Prophylactic measures are first in order, the causative factors being eliminated as far as possible. **Cleansing the mouth and all utensils used, and sterilization of feeding-bottle and all other feeding-instruments** each time they are used are imperative, to prevent reinfection. The first should be done gently, but thoroughly, four or five times a day. The next step is to counteract the acidity of the oral secretions by the frequent use of **alkaline washes and beverages**. **Sodium borate**, 20 grains (1.3 Gm.) to the ounce (30 c.c.); **sodium sulphite**, 60 grains (4 Gm.) to the ounce; a saturated solution of **potassium chlorate**, and pure **lime-water** are useful as mouth-washes. In some cases, especially where fetor of the breath is present, a 1 grain (0.06 Gm.) to the ounce (30

c.c.) solution of **potassium permanganate** or a solution of **hydrogen dioxide** is more effective. The atomizer may be used when the patient is too young to handle swabs or rinse his mouth. These measures should be repeated every hour. Local applications of a 3 to 5 per cent. solution of **silver nitrate** are beneficial in stubborn cases.

To alkalinize the beverages, **lime-water** may be added to the milk, in the case of infants, in the proportion of 1 to 4.

Sugar and sweets, starchy food, and all syrupy excipients, when remedies are prescribed, **should be avoided**. The systemic state requires careful attention; indeed, thrush sometimes persists notwithstanding all local measures, until a **change of air, good food, and tonics** have greatly improved the general health. Minute—*i.e.*, tonic—doses of **calomel** or **mercury bichloride** are valuable in this connection.

GANGRENOUS STOMATITIS (NOMA; CANCRUM ORIS; WANGENBRAND).

DEFINITION.—A disease usually observed in children, from 2 to 5 years old, in which a gangrenous process begins on the gums or inner side of the cheek and spreads with rapidity.

SYMPTOMS.—Gangrenous stomatitis begins almost always during convalescence from an acute febrile process in unusually debilitated children, the first lesion being a small nodule, dense and sensitive, appearing on the gum or the cheek. The skin and the neighboring mucous surface become rapidly hard and swelled or there is edema. There may be pain, but, as a rule, little discomfort. In mild cases

the primary ulceration may be limited to one of the starting points and finally heal under local treatment, leaving the parts deformed and the patient disfigured if penetration of the cheek has occurred; but in the vast majority of instances the necrotic process rapidly extends, the cheek is perforated, and the chin, the tongue, the jaws, and remote structures—such as the eyelids and ears—are involved in the destructive process.

Violent systemic manifestations are present. There are marked fever and practically intractable diarrhea, the breath becomes intensely foul, and the submaxillary and cervical glands are more or less enlarged. Edema of the feet and delirium are common. The prostration soon becomes alarming and all the evidences of fatal marasmus appear. The disease is usually fatal in from one to two weeks, but the patients are often carried off by affections that appear as complications—aspiration pneumonia, pulmonary gangrene, enterocolitis, endocarditis, etc. In short, the phenomena are those of a violent septicemia.

ETIOLOGY AND PATHOLOGY.

—The affection occurs in poorly fed children, especially girls living in damp, filthy quarters, and children recovering from various infectious diseases, especially measles, scarlatina, diphtheria, and typhoid fever. It is essentially a disease originating primarily in lowered vitality, and is not observed in vigorous healthy children.

The complications observed are usually ascribed to metastatic infiltration of the distant structures involved, except in the case of pneumonia, which is due to aspiration of gangrenous matter, and enterocolitis, due to the ingestion of gangrenous

detritus. A bacillus resembling that of diphtheria has been isolated by Bishop, Ryan, and Schimmelbusch; Babès and Zambilovici have also isolated a pathogenic organism capable of producing gangrene resembling noma in rabbits; but all these observations require further investigation.

TREATMENT. — Prophylactic measures are also of primary importance in this form of stomatitis. The child's diet should at once be changed to one calculated to increase general nutrition. **Nux vomica** and **gentian**, combined and in small doses, or **strychnine**, are advantageous to promote appetite. Strong **beef-juices**, **peptonized milk**, or **koumiss** should be given every two hours.

Some recommend the early use of fairly large doses of **diphtheria anti-toxin** in every case, of the disease and I have witnessed the case of a female adult who recovered under this treatment.

The local treatment consists in the destruction of the sphacelous areas by **caustics** after thorough cleansing. For the latter purpose a 1:500 solution of **potassium permanganate** is very useful, but **hydrogen dioxide**, **mercury bichloride**, or **phenol** solutions are preferred by some. These may be applied with an atomizer emitting a coarse spray. The **sloughs** must be thoroughly removed and the bottom of the ulcer fully exposed. This having been accomplished, a 10 per cent. solution of **cocaine** is applied to the wound, and after four or five minutes the latter is touched with pure **lactic acid** by means of a small cotton pledget wrapped around the end of a thin probe (Sajous). Every part of the cavity must be cauterized. This is to be repeated daily until

signs of resolution appear. **Nitric acid**, the **galvanocautery**, and the **Paquelin cautery** have also been recommended, but their use is more difficult. **Excision** under anesthesia is a safe and useful procedure. **Bromoform** and **bismuth subnitrate** are valuable to enhance the curative process when dusted on the cauterized ulcers. **Scrupulous cleanliness** of the **mouth** is imperative.

Mild **antiseptic washes** should be used frequently, and for the diminution of the fetor antiseptic **charcoal poultices** containing **boric** or **salicylic acid** are useful.

In favorable cases healing should be promoted by means of **stimulating antiseptic lotions** or **balsams**.

MERCURIAL STOMATITIS.

(See **MERCURY**, Vol. VI.)

ANOMALOUS FORMS OF STOMATITIS.

MEMBRANOUS, OR CROUPOUS, STOMATITIS.—True croupous stomatitis is always a complication of croupous angina, the membrane developing simultaneously with that of the tonsils. Diphtheritic stomatitis is rarely primary, but a complication of diphtheria of the fauces.

What is often called "membranous stomatitis," however, is but an aggravated form of aphthous stomatitis. The local inflammation is more intense: the aphthæ assume a development suggesting the presence of a diphtheritic or streptococcic pseudomembrane, while the ulcer, when the latter is removed, is deeper and larger. It is mainly observed in infants suffering from inherited syphilis or gonorrheal infection. In the adult it is occasionally caused by the local use of strong caustics. The treatment does not differ from that of

aphthous stomatitis, care being taken, however, to remove as far as possible the causative disorder.

FOOT-AND-MOUTH DISEASE, EPIDEMIC STOMATITIS, OR APHTHOUS FEVER.—An affection observed in lower animals (cattle, sheep, pigs, goats), and caused by an unknown micro-organism, is occasionally witnessed in the human being, particularly in children, the toxic element being transmitted through contaminated milk, cheese, or butter, or by inoculation while milking. The disease is said not to be transmitted through the meat of diseased animals.

SYMPTOMS.—The incubation period lasts from three to five days. The onset is marked by a rigor or mere slight shiverings, followed by fever and malaise. There are marked fever and gastrointestinal and bronchial irritation; a vesicular eruption appears upon the lips, mouth, and pharynx early in the history of the disease. The mouth is hot, the mucous membrane reddened and swollen, and salivation present. A miliary eruption, which may become pustular, may appear on the skin, especially on the fingers and hands. The tendency to hemorrhage is greater than in ulcerative pharyngitis.

DIAGNOSIS.—The diagnosis is readily made from the prevalence of the disease in lower animals and the peculiar coincidence noted in that the eruption appears only in the mouth and extremities, a coincidence not observed in any other eruptive disease.

PROGNOSIS.—The mortality in an epidemic studied by Siegel was 8 per cent.

TREATMENT.—The treatment indicated is that recommended in the

ulcerative form. Prophylaxis requires the use of milk from healthy animals, proper stable hygiene, and isolation of diseased animals.

Bednar's Aphthæ.—This is characterized by the presence, over the posterior part of the hard palate near the gums of infants, of white patches, or aphthæ, which sometimes overlies deep ulcers, the latter at times involving the bone. It is usually ascribed to the use of artificial nipples, to traumatism, such as that produced when the mouth is roughly cleansed by the nurse, or to the pressure of the tongue upon the mucous membrane while nursing. This form of stomatitis is overcome with difficulty. A shorter and softer nipple should be ordered when this cause is apparent and the measures indicated in ulcerative stomatitis resorted to.

Riga's disease (aphtha cachectica) has been observed almost exclusively in the southern provinces of Italy, where it seems to be endemic, occasionally attacking all the children in a family, whether the parents be healthy or not. It is observed: when the first teeth make their appearance, apart from whooping-cough, sometimes in children whose general health shows nothing wrong, sometimes in cachectic children who are exhausted by ordinary attacks of gastrointestinal catarrh. It begins as an ulceration under the tongue, close to the frenum. It is about the size of a flaxseed, and gradually enlarges to the size of a sixpence. It is gray in color and painless. The border is irregular and not sharply marked, and extends somewhat over the sound tissue. It may cause death, or, after a long time, recovery may take place. The children waste in flesh, their skin

becoming of an earthy hue. Enlargement of the liver and spleen occurs. There is no fever. Beginning at the age of 3 or 4 months, it frequently lasts until the twentieth month. It is mostly hereditary, and only seldom do the children of such families live, unless nursed at the breast of a healthy woman.

Parrot's Disease.—This disorder is observed in the newborn and debilitated children, and is characterized by the presence on both sides of the middle line of the hard palate of symmetrically disposed ulcers, which tend to increase in size. The ulceration often penetrates the underlying soft tissues to the bone, causing necrosis. It is a stubborn affection and requires the active measures advocated under ulcerative stomatitis.

Herpes zoster, or zona, of the mouth, as described by Hugenschmidt, is an inflammatory affection of one part and only one side of the buccal cavity, characterized by an eruption of herpetic vesicles, disposed in groups according to a regular direction. The eruption is preceded and accompanied by a neuralgic pain of the whole fifth nerve. The evolution of the disease may be divided into two periods: (1) the period of invasion; (2) the period of eruption. 1. Period of invasion begins by a rise of the temperature; there is fever; then headache, nausea, loss of appetite, etc.; intense neuralgia of the whole region of the fifth nerve. Fever lasts three days, and is followed by the period of eruption. 2. In period of eruption parts to be involved become excessively painful to the touch; mucous membrane is red and presents a series of little herpetic vesicles, disposed in groups and having size of a

pinhead; some of them are united. They assume a regular direction: usually the course of the nerve. No vesicles are to be found disseminated in the mouth. The neuralgia, which is general for the first three days, localizes itself as soon as the eruption occurs.

Very similar is a disorder described by Jacobi, also characterized by an herpetic eruption, and observed in neurotic subjects. In some cases it accompanies erythema multiforme. The treatment indicated is that of the general disorder.

La Perlèche.—This is a contagious disease characterized by the presence of ulcerations at the angle of the mouth. The probable cause is bacterial infection from drinking vessels.

Small elevations and fissures, resembling those of congenital syphilis, are seen at the angles of the mouth. When the mouth is opened these are stretched, causing smarting pain and bleeding. This causes the patient to lick the part and add more infection.

Burnt alum, silver nitrate, and covering the part with **bismuth** or **zinc oxide** are the most useful remedial measures.

LIPS, DISEASES OF.

INFLAMMATION, CRACKS, AND FISSURES.

Inflammation frequently occurs independently of oral or general affections as a result of cold during the winter months. When the slight vascular turgescence present is complicated with cracks or fissures, considerable discomfort results. Of diagnostic importance, however, is the fact that fissures, which are usually situated in the middle of the lips,

often betoken a strumous diathesis; enlarged cervical glands are, however, usually present in such cases. Again, cracks at the angles of the mouth suggest the possibility of general syphilis; the surrounding tissues in that case often appear sodden, while the fissure is apt to contain pus. Labial fissures are also often witnessed in women who, in threading a needle, first bite the thread and drag it between the lips before passing the tip through the eye (Jamieson).

TREATMENT.—Uncomplicated congestion of the lips soon yields to mild **astringents** or to a preparation such as the following, in which a resinoid substance is contained:—

℞ *Tincture of benzoin*,
Glycerin of each ℥ss.
Rose water, enough to
 make f℥iv.

When slight fissures or cracks are present, **rose-water ointment** or 10 grains (0.6 Gm.) of **salicylic acid** to the ounce (30 Gm.) of **cold cream** usually brings about prompt resolution. Fissures often resist all simple measures, and require the application of solid **silver nitrate** or powdered **alum**. In children persistent fissures leave deep furrows, and are apt to produce slight deformities. They should, therefore, be scraped with the **curette** under local anesthesia, and the edges of the wound drawn together and held in position by means of **court-plaster** until healed.

HERPÈS LABIALIS (FEVER BLISTER). See HERPES, Vol. V.

TUMORS OF THE LIPS.

Of all primary neoplasms, about 3 per cent. originate in the lips; but these structures show a higher percentage when cancer is alone considered, viz., about 5 per cent. As

compared to other forms of tumor observed in this region,—papilloma, sarcoma, angioma, fibroma, and cystoma,—cancer is observed in 99 per cent. of cases.

CARCINOMA.—This variety of growth almost exclusively develops in the lower lip. Of 352 cases analyzed by W. R. Williams, 340 originated on the lower lip. Among 1193 instances studied by Fricke the upper lip was affected in but 63 cases. The predilection of this situation for the development of cancer as regards sexes is as striking. In the series of cases just mentioned 94 per cent. occurred in males. It is essentially a disease of adult and advanced life, the average being about 60 years; but carcinoma has been observed long before the fortieth year, the limit usually accepted. Fricke's list ranged from 24 to 83 years. A large proportion of the cases were in laborers and farmers, and heredity seemed to play a minor rôle. Pipe-smoking appeared to be an important predisposing factor, wounds and abrasions coming next in order.

Symptoms.—A labial cancer may begin as a mere excoriation, fissure, or ulcer that will not heal; a small tubercle covered by a thick scab that recurs as soon as picked off, or as a warty growth. The ulceration gradually spreads and deepens, the surrounding tissues being infiltrated and hard. In many cases the carcinoma begins as an ulcerating induration. The ulcer gradually assumes the typical appearance of an epitheliomatous growth, with an irregular, sloughing base and abrupt, everted edges. When irritated by the injudicious use of caustics or "specifics," it tends to fungate and its growth becomes more

rapid. At this stage it usually becomes quite painful, and nutrition soon suffers through the inability of the patient to take sufficient food, and a state of marasmus soon becomes evident, owing to repeated hemorrhages, the ingestion of cancerous detritus, etc. General toxemia is by this time fully demonstrated by the patient's facies, and he sinks with increasing rapidity until death relieves him of his suffering. As a rule, the development is very gradual, and the glands of the jaws are not involved early. Enlargement of these glands and even their induration do not necessarily imply carcinomatous infiltration. Glands examined immediately after removal have been found free of malignant degeneration (Fricke); but there is no doubt that such glands constitute foci for carcinomatous changes and that they should be removed whenever possible.

Diagnosis.—Chancre of the lip sometimes renders the diagnosis somewhat difficult. Carcinoma, as we have seen, occurs almost always in men; chancre is more frequently observed in women than in men, and may occur at any age, while cancer seldom occurs before the fortieth year. The progress of cancer is slow and the involvement of lymphatic glands is tardy; chancre advances rapidly, lasts but a few weeks, and the glands are soon involved. Finally the secondary manifestations appear in syphilis and greatly improve under specific treatment. Cancer progresses regardless of all internal remedies.

Prognosis.—In Fricke's statistics operative procedures resulted as follows: 8 per cent. died as an immediate result of the operation, 32 per cent. suffered from recurrence, and 60

per cent. were permanently cured. The prognosis of labial cancer is, therefore, good if operation is resorted to—before, however, the maxillary and parotid glands are involved in the cancerous process. The prognosis is also unfavorable when the infiltration has reached the jaw or has extended to neighboring organs.

Treatment.—Local treatment by caustics and other “specifics” but compromises the ultimate issue. **Surgical removal** resorted to early affords the patient excellent chances of recovery. Of all cancers, that of the lip has shown the least tendency to recur.

MISCELLANEOUS GROWTHS.

Besides the varieties of neoplasms enumerated and which do not depart, in the physical phenomena, from similar neoplasms observed elsewhere in the organism, **nevi** (see BLOOD-VESSELS, TUMORS OF, Vol. II) are sometimes witnessed in this location. But, as a rule, they are small and may generally be removed by **ignipuncture**, a fine galvanocautery knife being used, or by **electrolysis**. The latter is slower, however. **Dissection**, as if the growth were a malignant one, is sometimes necessary.

JAWS, DISEASES OF.

ALVEOLAR ABSCESS.—A suppurative dental periostitis due to diseased teeth. The simplest form, in which there is inflammation between the bone and the gum externally to the root of the tooth, is known as a **gum-boil**. The condition is generally quite superficial, and gives rise to but few external signs. When it is due to a disorder at the root of a tooth a true alveolar abscess is formed and the active manifestations are accompanied by severe throbbing pain, con-

siderable swelling of the cheek of the corresponding side, and with protrusion of the tooth from thickening of the peridental tissues. When the lateral incisors are involved, the abscess may spread posteriorly between the layers of the hard palate, or anteriorly in the direction of the nose, opening into the latter. When the molars are involved, it may penetrate the tissues of the face, thus leaving a sinus or scar. Necrosis and pyemia have occurred in rare instances as complications.

Treatment.—The old-fashioned linseed-meal poultice is worse than useless, tending to encourage the inflammatory process and to involve the cheek. **Water** as hot as can be borne, held in the mouth, is far better. Painting the gums with a 10 per cent. solution of **cocaine** is sometimes temporarily effective in mild cases. **Free leeching** or **lancing** can be resorted to if the abscess progresses. Leeches should always be applied through leech glasses, and not wrapped in a napkin, as is often done. If these measures do not suffice the patient should consult a dentist.

EPULIS.

Although applied to various neoplasms of the gums, the term “epulis” is only applicable to a growth of the alveolar process and tooth-sockets. Two varieties of epulis are recognized: the *simple*, or benign, and the *malignant*.

Simple Epulis.—A benign epulis is, in reality, a fibroma: a smooth, rounded projection of the gum, usually beginning between two teeth, which it gradually separates, displaces, and loosens. It may involve several teeth and involve the posterior or the anterior aspect of the alveolus.

It is painless, of slow and indolent growth, but, if left to itself, it ulcerates and causes marked deformity. It sometimes ossifies or becomes sarcomatous.

Malignant Epulis.—This is a much more dangerous variety. Beginning usually at the socket, it is characterized by the presence of an irregular, multinucleated mass of giant cells associated either with round or spindle cells, or both. It is really a myeloid sarcoma. It is exceedingly vascular, purplish red, grows much more rapidly than the simple epulis, and is finally transformed into a spongy mass, which projects in various directions and bleeds upon the least contact with a hard substance.

TREATMENT.—Whether the growth present be a simple or malignant one, the sooner it is removed, the better. The tumor, and the tooth or teeth and the portion of the alveolar process involved, should be **excised**, this constituting the only safe mode of treatment. Mere scraping is followed by a return of the tumor in almost every case, whether simple or malignant. The portions of bone to be removed being mapped out, two vertical incisions are made with a Hey saw, and the diseased mass is removed with forceps, after having been dissected from its surroundings.

NECROSIS.

Necrosis of the jaw may be due to any condition liable to give rise to inflammation of its periosteum by injury due to the extraction or improper manipulation of teeth, by various suppurative diseases, the acute exanthemata, pyemia, actinomycosis, etc., or by the action of various diathetic processes, such as syphilis, tuberculosis, or leprosy. It is most fre-

quently caused by the fumes of phosphorus (see beyond), and by mercury taken internally. Deficient nutrition, scorbutus, or other conditions in which the organism is deprived of its vital pabulum frequently manifests necrosis of the jaws as a symptom. It may thus occur at any age, and does seem to show a predilection for either the upper or lower maxillary.

Necrosis is always preceded by deeply seated and intense pain; the parts are red, inflamed, and tumefied. After a time the pain is somewhat reduced and sinuses are formed, from which a fetid pus exudes. The teeth are loosened and fall out, and the cavity left is bathed in pus. A probe passed into any of the sinuses reveals the presence of dead bone by conveying to touch the characteristic sensation of roughness. Portions of the bone become detached and are easily removed.

PHOSPHORUS NECROSIS.

SYMPTOMS.—Phosphorus necrosis comes on gradually, and sometimes long after the patient has been exposed to its toxic influence in connection with his occupation, the manufacture of matches, etc. But, once started, it progresses rapidly, involving large areas of bone; owing to the general toxemia, many foci of inflammation may be developed at once. The lower jaw seems to be that in which phosphorus necrosis most frequently occurs.

Pain is one of the earliest symptoms; at first intermittent, it soon becomes continuous. Suppuration of the perialveolar and peridental membranes occurs, pus appears at the alveoli, and the inflammation soon includes the gum structures, the tissues of the face becoming infiltrated, and

the characteristic deformity appears. The entire periosteal layer is then invaded; sinuses are formed, opening into the mouth and externally under the lower maxillary edge, and pus is exuded on all sides. The pain becomes less marked when this stage is reached, unless the necrotic process involves the condyle, when severe pain in the ear is experienced.

The general health of the patient soon suffers considerably. The constant discharge, the presence of offensive pus in the mouth and stomach (much of the discharge being swallowed), the occlusion of the jaws through infiltration of the maxillary muscles, and the impediment to the ingestion of food combine to rapidly bring on exhaustion and death unless proper treatment is instituted.

In some cases, however, the process is a slow one, and comparative health is enjoyed, while now and then a necrotic sequestrum is discharged through one of the sinuses.

In some operatives, however, a special susceptibility to phosphorus exists, and acute symptoms—nausea and vomiting, etc.—indicate an acute poisoning that requires immediate cessation of all work in which phosphorus is handled or inhaled.

ETIOLOGY AND PATHOLOGY.

—The inhalation of the vapor of phosphorus and the particles of this substance taken in with the food when the hands are not properly cleansed and improper care of the teeth combine to very gradually bring on the general toxemia. This, in turn, gives rise to slow disintegration of the red blood-corpuscles and fatty degeneration of the arterial coats. That the maxillary bones should, of the entire osseous system, bear the

brunt of the disease demonstrates that a local factor must play a prominent part in the disease. It is thought that the periodontal membrane laid bare by accumulation of tartar, and whose vascular supply is already diseased by the general toxemia, is easily influenced by any phosphorus that may enter the mouth, and thus readily yields to the irritation induced, carious teeth, and other infectious foci, and that the necrotic process follows the local inflammation engendered.

TREATMENT.—In the early stages the teeth should receive careful attention, carious ones being **extracted**, while the **tartar** around those not diseased should be carefully **removed**. These manipulations should be conducted antiseptically, strict **care of the teeth** following.

Turpentine, according to Hohler and Schimpf, when exposed some time to the air becomes rich in ozone, and prevents fatty degeneration. Theoretically, it is thus capable of neutralizing the effects of phosphorus, a power which has also been demonstrated practically. Andant found that it arrested the vapor of phosphorus in the dark. The ordinary American oil of turpentine is of no value, however, unless it be long exposed to the air. It is to be administered internally and by inhalation. **Potassium permanganate** is also a useful antidotal agent. **Lime-water** and **magnesia** are said to be helpful in preventing the drug from affecting the tissues. The general health should be carefully watched and every means used to facilitate increased nutrition by the use of **tonics** and **easily digested foods**.

In the stage of ulceration **antiseptic**

washes as warm as possible should be frequently used. A weak **potassium permanganate** solution is particularly valuable in this connection, when syringed into the sinuses. This being done, **iodoform gauze** can be packed in to absorb secretions, to avoid their mixture with food. **Sequestra** should be **removed** when free, and the **cavity packed**. Mears advises that, when the lower jaw is involved, but half of the **ramus** be **removed** at one time, in order to preserve the contour of the parts. After the expiration of eight or ten weeks the remaining portion may be removed.

When the patient cannot avoid exposure to phosphorus fumes, the preventive measures should consist in **free ventilation, absolute cleanliness, especially of the mouth and hands, and disengagement of the vapor of turpentine in working-rooms**. Cloths may be soaked in this substance and spread out close to where the exposed subject is working.

J. MADISON TAYLOR
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Philadelphia.

MUMPS. See SALIVARY GLANDS, DISEASES OF.

MUSCLES, DISEASES OF THE.

MYOSITIS.

Inflammation of muscles may be primary or secondary, general or local, parenchymatous or interstitial, and suppurative or non-suppurative, the different forms running an acute, sub-acute, or chronic course. As a rule, only the voluntary muscles are involved, an exception to this being the heart muscle.

Owing to the obscurity regarding

the etiology of certain forms of myositis, various classifications have been proposed. Lorenz divided the myositides into three groups,—suppurative, non-suppurative, and myositis with special terminal lesions. Batten gives three main groups,—primary, secondary, and myositis with special terminal lesions, placing the suppurative form in the second group, while Kader considered the advisability of including both the suppurative and non-suppurative forms under the general heading of infectious myositis.

For a discussion of myositis occurring in the course of infectious diseases, such as typhoid fever, syphilis, tuberculosis, gonorrhea, actinomycosis, etc., the reader is referred to the several sections on these diseases.

PRIMARY SUPPURATIVE MYOSITIS.—**Synonyms.**—Diffuse suppurative myositis; infectious myositis; idiopathic, acute, suppurative muscle inflammation.

Definition.—A bacterial infection of one or more muscles, usually running an acute course and terminating, as a rule, in suppuration.

Case of myositis purulenta acuta in which the typhoid bacillus was found culturally and immunologically to have caused the purulent lesion. The latter was located in the right upper arm from the elbow to the deltoid insertion, beginning as a painful reddish swelling about two weeks after the onset of chills and fever. Terada (*Sei-I-Kwai Med. Jour.*, Mar. 10, 1918).

Symptoms.—The onset of primary suppurative myositis is like that of an acute infectious fever. It is ushered in by a chill, with rise of temperature, headache, and generalized pains, which are soon referred to the muscles. The affection may be limited to a single muscle, or many muscles may

be involved. Those affected are swollen, indurated, spontaneously painful, tender upon manipulation, and non-adherent to the surrounding tissues. The muscles are in a state of contraction, causing limitation of both active and passive movements. The overlying skin may be erythematous, but, as a rule, it is normal in appearance. Edema of the subcutaneous tissue may be present.

Any attempt to move the affected muscles causes severe pain and if the affection is at all general the patient soon becomes helpless. In a few days, in the great majority of cases, the indurated masses soften and signs of suppuration become evident. In a small percentage of cases resolution occurs without abscess formation.

Unless the pus is promptly evacuated there is danger of metastasis through infiltration of the pus into the surrounding tissues.

The muscles most frequently involved are those of the upper and lower extremities, chest, and lumbar region. One muscle alone is affected in the majority of instances, 2 frequently, and as many as 18 were found involved in one case reported.

Recurrence is rare, but the condition has been known to reappear after a few months' interval.

Diagnosis.—The pain and tenderness referred to the affected muscles and the characteristic induration and swelling conforming to the shape of the muscles, together with the abrupt febrile onset, should render comparatively easy the recognition of primary suppurative myositis.

Cases in which metastasis has occurred must be separated from the metastatic abscesses occurring in pyemia. In the latter affection the mus-

cular induration and contraction would be absent.

Suppurative myositis may superficially resemble osteomyelitis in cases where the abscess has broken through the muscle sheath.

Pathology.—The muscles affected vary in appearance according to the stage and intensity of the inflammatory process. Early they are dark red, later becoming grayish red from the infiltration and breaking down of the tissue. The muscles may show diffuse purulent infiltration, multiple small abscesses, or a larger solitary abscess. The abscess wall is composed of grayish-yellow, necrotic muscle tissue and the cavity filled with a thick, yellow or greenish-yellow pus containing necrotic tissue and sometimes blood. The abscess may be so large as practically to include the entire muscle. The overlying skin and subcutaneous tissues are, as a rule, uninvolved.

Microscopically, both interstitial and parenchymatous changes are seen. In the early stages the interstitial tissue may not show much change, but it is considerably increased in long-standing cases and may almost entirely replace the muscle tissue. The muscle fibers likewise may show but slight change, or may be swollen, with disappearance of the cross-striation (Scriba). There is usually a proliferation of the muscle nuclei, and vacuolic degeneration of the fibers has been observed (Lorenz). Round-cell infiltration is sometimes seen in the muscle sheath and interstitial tissue, and is always present in the tissue forming the wall of the abscess, which also contains bacteria.

Etiology.—Age, sex, and occupation play unimportant rôles in the causation

MUSCLES, DISEASES OF THE (PRICE)

of primary suppurative myositis, except in so far as they predispose to overexertion, exposure, and trauma. These factors act by lowering the resistance of the muscles to infection, Miyake (quoted by Steiner) having shown experimentally that overuse of a muscle could cause separation of its fibers, with the occurrence of punctiform hemorrhages which offer a favorable site for the development of infection.

The pus from the muscle abscesses has been found to contain micro-organisms in almost every instance in which these have been searched for. Staphylococci, streptococci, a diplococcus resembling the pneumococcus, and an unidentified bacillus have been obtained in cultures from the abscesses by different observers. The *Staphylococcus pyogenes aureus* is the chief offender, having been found in pure culture in the majority of cases. The credit for the first reported finding of micro-organisms in primary suppurative myositis belongs to Scriba and Brunon.

The bacteria make their entrances chiefly through the skin by way of infected foci, less frequently through the mucous membranes, and from these ports of entry are conveyed through the blood-vessels to the muscles. The disease has been aptly described by Steiner as a "septicopyemic" infection.

While suppurative myositis has a widespread distribution, it is far more prevalent in Japan than in any other country, Japanese observers believing this is due to diet, climate, and racial peculiarities.

Prognosis.—The outlook for recovery is favorable if the condition is promptly diagnosed and properly

treated by incision and evacuation of the pus, recovery taking place in from six to twelve weeks. Unpleasant but fortunately rare sequelæ are muscle atrophy or deformities from contraction of scar tissue.

In cases which are unrecognized and in which rupture of the abscesses occurs, with subsequent formation of metastatic abscesses, the prognosis is obviously grave. Death may result from endocarditis or pneumonia.

Treatment.—At the onset, free purgation with the local application of cold may in some instances cause resolution without suppuration. Free incision and drainage are, of course, indicated as soon as fluctuation occurs. In the later stages of the disease massage and passive movements are of value in preventing contractures.

ACUTE POLYMYOSITIS.—Synonyms.—Dermatomyositis; dermatomucosomyositis; pseudotrichinosis.

Definition.—A disease characterized by inflammation of the skin and muscles, non-suppurative, and running an acute, subacute, or chronic course.

History.—The first accurate description of this disease dates from the cases published, with autopsy, by Unverricht (Münch. med. Woch., 1887, xxxiv, 488), Hepp (Zeit. f. klin. Med., 1887, xii, 533), and E. Wagner (Deut. Archiv f. klin. Med., 1886-87, xi, 241) in 1887.

The patients were aged 24, 36, and 34 years, respectively, and had in common inflamed, painful, and swollen muscles, with edema of the overlying subcutaneous tissue. Unverricht's case had an urticaria-like eruption, Hepp's patient an exanthem on the face and chest, while Wagner found an erysipelas-like dermatitis on each arm of his patient. Two of the 3 cases died of lobar pneumonia, the third in a suffocation attack. Varying degrees of muscle degeneration with interstitial round-cell infiltration and minute interfibrillar hemorrhages were found in each instance.

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Löwenfeld (Münch. med. Woch., 1890, No. 31) in 1890 reported a case in which the heart muscle was apparently the first to be involved, and, in 1891, Strümpell (Zeit. für Nervenheilkunde, i, 1891) described a case with ptosis and ocular paralysis. Steiner (Jour. of Exper. Med., 1903, vi, 407) in 1903 collected 28 typical cases from the literature, several with necropsy.

Symptoms.—The disease, as a rule, develops gradually with malaise, general weakness, anorexia, headache, and occasionally vomiting. Rarely this prodromal period is absent and the onset is more abrupt. Fever, usually moderate in degree and intermittent in character, soon appears; then local symptoms develop. Pain, at first vague, rapidly becomes referred to the muscles, group after group of which become successively involved. The muscles become tender and rigid; the extremities swollen and edematous. The edema may affect also the face and trunk.

An early and characteristic symptom is a dermatitis, which may be limited to areas over the affected muscles or may spread and become more general. It appears in the form of a rash, which varies in different cases. It may occur as an erythema resembling the skin appearance in erysipelas, as an erythema nodosum, an urticaria, or a roseola.

The spleen becomes enlarged and tender and albumin and hyaline and granular casts are sometimes found in the urine.

Stomatitis and ulceration of mucous membranes are not infrequent symptoms. Outside of the pain, sensory symptoms are not marked; paresthesiæ are sometimes present, but there is never any sensory loss. The inflammation may spread to the muscles

of deglutition, giving rise to difficulty in swallowing, and implication of the respiratory muscles sometimes causes death from suffocation or bronchopneumonia.

The reflexes are preserved, but may be difficult to elicit on account of the swelling and edema of the extremities. Electrical reactions are normal early in the disease, later showing a quantitative decrease (Oppenheim).

In the more severe cases atrophy of the muscles, with partial reactions of degeneration (Lewy), is occasionally seen, and a marked pigmentation may follow the dermatitis.

Diagnosis.—The diagnosis of dermatomyositis should not be difficult if the following characteristic features of the disease are borne in mind: the gradual onset, the dermatitis, the muscular pain and tenderness, and the edema of the subcutaneous tissue.

In trichinosis there would be a history of the patient eating raw or partially cooked pork, and the *Trichinella spiralis* would be found in the stools and in excised portions of the affected muscles. In long-standing cases a skiagram may show calcification in the sheath of the trichinæ (Batten). The initial gastrointestinal symptoms and a marked eosinophilia are also of assistance in the separation of this disease from dermatomyositis, and still another point in the differentiation is the early involvement of the eye muscles and of the diaphragm in trichinosis.

Neuromyositis presents symptoms of nerve involvement, as sensory loss, muscular atrophy, and absent kneejerks, and dermatitis is absent.

Primary suppurative myositis has a more acute onset and exhibits infected

foci with abscess formation; bacteria are found in the affected areas.

In syphilitic myositis there would be a history of specific infection and the blood would give a positive Wassermann reaction.

Pathology.—Almost all the muscles of the body may be implicated, although the ocular muscles and the masseters generally escape (Batten). The changes that take place may be most marked in the parenchyma, or in the interstitial tissue, or they may be equally diffused. The affected muscles are swollen, lusterless, generally of a pale-red or yellowish color, and often covered with grayish or reddish patches or streaks. In consistency the muscles vary greatly; they may be hard and firm or soft and friable. Hemorrhages large enough to be visible to the naked eye are sometimes observed in the muscles.

Microscopically, changes have been found in the muscle fibers, in the interstitial tissue, and to a slight extent in the blood-vessels. The lesions may be localized or more or less widely diffused. The muscle fibers are swollen and present varying degrees of degenerative change, such as hyaline, granular, waxy, and rarely fatty. The striæ are generally absent or indistinct, and vacuoles are occasionally seen. In almost every case an increase of the nuclei is noted. Round-cell infiltration takes place between the fibers, especially in the vicinity of the blood-vessels, which are apt to be dilated and engorged. Hemorrhages form a part of the pathological picture in the majority of instances. In the subacute and chronic forms there is a marked connective-tissue increase, especially in the perimysium. It is probable that the changes in the

parenchyma are secondary to the acute interstitial changes (Pfeiffer, Lorenz). The subcutaneous tissues overlying the affected muscles show an inflammatory edema. The spleen is invariably enlarged and softened, and the lungs have frequently shown a bronchopneumonia at autopsy.

Etiology.—The cause of dermatomyositis is as yet undetermined. The disease has been variously considered as being (1) of toxic origin; (2) as being due to a vegetable parasite, and (3) as being caused by an animal parasite.

Senator (Deut. med. Woch., 1893, xix, 933) advocated the theory of a toxic origin, a case reported by him having developed the malady after eating stale crabs. Kell (Jour. Amer. Med. Assoc., 1896, xxvi, 967) added further support to this theory through the report of 3 cases occurring after partaking of fish. Unverricht suggested that the disease was due to an animal parasite belonging to the order Gregarinoidea, and later Lorenz found a sporozoön-like parasite in one of his cases. In the majority of cases examined, however, results have been negative; yet the rise of temperature accompanying the skin and muscle symptoms, and the constant finding of an enlarged spleen, certainly point toward a probable infectious origin. Nothing conclusive has as yet been advanced to indicate that the disease is contagious.

Blood-culture finding in a case of acute polymyositis which supports the view that this disease is a bacteremia due to a micrococcus, with rather uniform predilection for the musculature. The infection assumes the form of polymyositis when a *Micrococcus pyogenes* bacteremia occurs in a person whose condition favors rheu-

matism, although there is no pathological basis for this, as the lesions are different. Herbert Fox (*Amer. Jour. Med. Sci.*, June, 1913).

Polymyositis occurs in the two sexes with nearly equal frequency, the malady slightly predominating in males. Age does not appear to be a very important factor, for although adults are most frequently affected, cases have been recorded occurring both in childhood and in advanced age.

The disease has a wide distribution, cases having been found in this country as well as in various countries abroad, England and Germany having contributed the largest number. Steiner has reported a case of polymyositis in a negro.

Prognosis.—The acute forms last from a few weeks to two months, chronic cases extending over a period of from one to two years, with the subacute forms running an intermediate course. Any case is apt to have remissions and relapses. That in Steiner's series of 28 cases 17 were fatal affords an idea of the seriousness of the affection, and even when recovery does occur there may be more or less muscular atrophy.

Treatment.—When the patient is seen early, relief of the pain is the first consideration. **Aspirin** and the **salicylates** are of some advantage, and in severe cases it may be necessary to resort to the administration of **morphine**. The **nutrition** of the patient should be kept up, and if pneumonia develops, it, of course, requires appropriate treatment. In the later stages of the disease **passive movements**, **massage**, and **electricity** are useful measures for the prevention or treatment of muscular atrophy.

MYOSITIS HEMORRHAGICA.
— **Synonym.** — Polymyositis hemorrhagica.

Definition.—A form of myositis characterized by the presence of intramuscular hemorrhage, usually having an acute onset, and running an acute, subacute, or chronic course.

History.—Vernon has the credit of placing, in 1888, the first case of this disease on record (*Archives de méd. et de pharm. mil.*, 1888, xi, 481). Thayer, in 1902, was able to find but 9 cases in the literature, to which he added 1 of his own.

Symptoms.—There is an acute onset, usually without prodromal symptoms, but attended with fever, pain in the extremities, and swelling of the muscles. The muscles of the lower extremities are generally affected first, and in common with those involved later are hard and very tender upon manipulation. Starting in a single muscle or group of muscles, the condition spreads and may ultimately involve almost the entire voluntary muscle system. Owing to the severity of the pain and tenderness, voluntary movements of the extremities are greatly restricted. Edema of the subcutaneous tissues may be present and the skin becomes hyperemic, often purpuric, or even hemorrhagic. Later it becomes discolored or pigmented as the eruption disappears. Muscle atrophy is a rare sequel.

The myocardium is invariably affected, this leading to a wide range of circulatory symptoms varying from cardiac palpitation to dilatation, and not infrequently death results from cardiac failure. Bleeding from mucous membranes is not infrequent. Unlike dermatomyositis, the condition is generally not associated with enlargement of the spleen. Nephritis

is frequent, albumin and casts being found in the urine.

Diagnosis.—The following points should be remembered: The acute onset with fever, a hemorrhagic or purpuric skin eruption, and marked circulatory symptoms from the myocarditis.

Pathology.—Macroscopically the muscles, including the myocardium, are reddish brown in color, and contain numerous hemorrhagic foci. Microscopically, intramuscular hemorrhages are found between the muscle fibers, the latter in many instances having lost their nuclei and undergone vacuolation and degeneration. In the chronic cases there is a marked increase of connective tissue and more or less atrophy of the muscle fibers, and the presence of blood-pigment is noted.

Etiology.—The cause of myositis hemorrhagica is still undetermined, but is thought to be some form of infection. The disease has been known to follow sore throat and cervical cellulitis each in one instance, and in 2 cases staphylococci were obtained.

Prognosis.—The prognosis is grave, a majority of the cases terminating fatally.

Treatment.—The same measures are indicated as in dermatomyositis.

MYOSITIS FIBROSA.—**Definition.**—A rare disease characterized by inflammation of one or more muscles, which later become replaced more or less completely by fibrous tissue. The disease is of unknown origin, and runs a subacute or chronic course.

History.—Recognition of the disease dates from the report of a case by Gies in 1878 (*Deut. Zeit. f. Chir.*, 1879, xi, 161). Since that time but few cases have been recorded.

Symptoms.—The onset is gradual, beginning usually in the lower extremities. The disease progresses slowly and affects in turn different muscles or muscle groups. In one instance the disease was first manifest in the sternomastoid muscle (Janicke). Spontaneous pain may be a prominent symptom, but was absent in one case seen by Batten. The muscles are not especially painful upon palpation. Fever is absent. As the condition advances, contractures develop, the flexors of the extremities being chiefly implicated. The back becomes curved and the head flexed on the chest, the patient becoming ultimately rigid and helpless.

Muscular response to the faradic current is diminished or absent. Reactions of degeneration have not been reported. Sensation is, as a rule, unaffected.

Diagnosis.—It is difficult to separate myositis fibrosa from other forms of myositis. The diagnosis should be based chiefly upon the histological examination of a piece of muscle. In the other forms of myositis there is usually severe pain upon palpation of the affected muscle. This is slight or absent in myositis fibrosa.

The rigidity and contractures of cerebral diplegia present a superficial resemblance, but the signs of upper motor segment disease, such as increased reflexes, ankle clonus, and Babinski's sign, at once afford information of the true nature of the condition.

Myopathy could hardly be mistaken for myositis fibrosa unless contractures were marked.

Pathology.—The main feature is increase of connective tissue at the expense of the muscle fibers. The muscles are hard and firm and may be

swollen, presenting a tumor-like appearance.

In other cases the muscles are smaller than normal, but still hard and fibrous. Edema of the overlying tissues may be present.

On section the muscles present the white appearance of fibrous tissue, with reddish-yellow spots showing as the remains of the muscle fibers.

Microscopically, the muscle fibers show atrophy and granular degeneration, with disappearance of the cross-striations. Tendinous tissue appears to be increased, but, as Batten suggests, this may be only relative, resulting from the shortening of the muscles.

Etiology.—There has been much speculation as to the cause of myositis fibrosa. It has been variously considered as being of rheumatic origin, as a chronic form of primary non-suppurative myositis (Kader), as being related to osteomyelitis (Hackenbruch), and as belonging to the abiotrophies. Although the condition has been thought by some to be postinfectious, no micro-organisms have as yet been obtained in these cases. Trauma and syphilis seem to have no connection with the condition. It begins, usually, in early life.

Prognosis.—As a rule, the disease is steadily progressive, but instances of recovery have been reported. Improvement is always a probability, and the disease may be arrested and remain stationary.

Treatment.—**Massage, passive movements, electricity, and hot-air baths** are advocated early in the disease, and recovery has followed their use in some instances. Drugs have so far proved valueless. Batten has

suggested the use of injections of **thiosinamine** (fibrolysin) on theoretical grounds, but, so far as I can learn, these have not been tried.

MYOSITIS OSSIFICANS PROGRESSIVA.

DEFINITION.—A chronic, progressive, inflammatory condition, of unknown origin, characterized by the formation of osseous tissue in the muscles, tendons, fascia, and ligaments, with outgrowths from the bony skeleton.

Records of a small number of instances of progressive ossification of the muscular system have accumulated during the last century and a half and several medical museums contain skeletons in which massive bands of bone occupying the site of muscles are attached to the vertebrae, ribs, or pelvis and often rigidly unite them to the bones of the arm or thigh. Other instances of ossification, usually beginning during the first years of life and slowly implicating one muscle or group of muscles after another, have been described. Many of those affected show an anomaly of the great toes and in some instances of the thumbs. Both great toes are of small size, not extending beyond the first interphalangeal joint of the second toe. Opie (*Jour. Med. Research*, xxxvi, 267, 1917).

SYMPTOMS.—The onset of the disease is slow, the first symptom being a local swelling, usually painful, in some part of the muscular system, generally appearing first on the back of the neck. The muscle or muscles affected are indurated, the overlying subcutaneous tissues are edematous, and the skin slightly reddened or unaffected. Accompanying these phenomena, as a rule, is a slight rise of temperature. In a few days the swelling diminishes, but the muscle remains more or less indurated.

Then there is usually a quiescent period of a few weeks or even months' duration, followed by the occurrence of another attack. A series of these recurring attacks is the characteristic feature of the earlier stage of the disease. The majority of the muscular swellings ultimately become bone, some only reach the fibrous stage, while in a few the swelling disappears, leaving an atrophied muscle. In rare instances the swelling subsides and the muscle, instead of undergoing degenerative change, returns to normal.

In Lorenz's group of cases the disease commenced in the muscles of the back and neck in 21 out of 38 instances; in 7 it began in the shoulder muscles; the onset of the rest was distributed between the face and the upper and lower extremities. The affected muscles become ossified in from three to eight months, the process being usually painless, but causing rigidity and fixation of position. On account of the early implication of the muscles of the back of the neck and of the ligaments in the same region, the head is held forward or to one side. Later, as the ligaments and tendons become ossified and bony outgrowths appear from the skeleton itself, the shoulder-blades become bound to the back and the arms can be moved but little, being usually fixed in a flexed position at the elbows. The muscles of the back become attached to the skeleton, the spinous processes form a continuous bony column, and the back becomes rigid. The lower extremities are involved later and to a less extent, but the hips and knees may ultimately become locked in the same manner as the joints of the upper

extremities. Implication of the masseter, temporal, and pterygoid muscles not only prevents mastication of food, but may fix the jaw so as to make even the introduction of liquids through the mouth a matter of considerable difficulty.

The eye muscles are usually unaffected, but have been involved in rare instances. The muscles that escape are the muscles of facial expression, the tongue, the muscles of deglutition, the diaphragm, the perineal muscles, the muscles of the genital apparatus, and the sphincters. The hands and feet are practically always exempt.

Response of the muscles to the faradic current is either normal, diminished, or lost, and in rare instances reactions of degeneration have been found.

The skin and subcutaneous tissues overlying the affected muscles may slough from pressure and irritation, ulcers forming and rendering the patient liable to septic infection.

The establishment of the menstrual function is apt to be much delayed if the disease occurs in girls before puberty, and the menses are usually arrested if the malady occurs after this function has made its appearance.

A striking feature of the disorder and one which lends support to the theory of its resulting in part from a congenital defect is its association with congenital deformities, of which microdactyly is the most common, occurring in three-fourths of the cases. This peculiar condition was first described by Gerber and later emphasized by Helferich. The great toes and the thumbs are shorter than normal, because of a shortening of the phalanges, which, being united by a

bony ankylosis, gave the impression of an absent proximal phalanx until the X-ray revealed the true character of the deformity. The great toe is not as long as the second toe, and often points outward and sometimes under the adjoining toe. In the hands the shortening is not always limited to the thumbs, a corresponding defect of growth being sometimes observed in association with this in the little fingers. Among other malformations that have been noted are sexual infantilism; atrophy of the mammæ, testicles, and scrotum; absence of certain muscles, and absence of the upper incisor teeth. Sympton (Brit. Med. Jour., ii, 1886, p. 1026) reported the interesting and much-quoted finding of microdactyly occurring in the father of a case of myositis ossificans, although the man had no evidence of the muscle disease.

According to Sidney Lang, radiographer to the Cincinnati Hospital, the X-ray picture of the stage of ossification is characteristic, and it is described by him as follows: "Osseous masses, usually elongated or ribbon-shaped bands at first, are seen among the muscle fibers and running parallel to them. These masses branch in irregular fashion and take on irregular and grotesque shapes. Although they are believed to originate primarily in the muscles, some of the masses may be seen adherent to and apparently an outgrowth of the neighboring periosteum and bone" (Lancet-Clinic, May 20, 1911, cv, No. 20, p. 520).

DIAGNOSIS.—Early cases are frequently considered as rheumatic or the result of trauma. After the disease has progressed, however, its symptoms are so distinctive that they

could hardly be mistaken for any other condition.

Multiple exostoses occur at the diaphyses and epiphyses and in this condition the muscles are not primarily affected.

As pointed out by Coley (Annals of Surg., March, 1913, lvii, No. 3), myositis ossificans developing in a young adult shortly after an injury would present a history almost identical with that observed in sarcoma. In myositis ossificans pain in the early stages is marked, while in sarcoma it is usually absent. In the former condition increase in size of the tumor, if present, would be slight, while in the latter affection there would be a steady and fairly rapid enlargement. Palpation would reveal a difference in consistency of the tumors, that of myositis being harder than that of sarcoma.

In periostitis and osteomyelitis the pain is more severe and worse at night, and the muscles, as in multiple exostoses, are not affected primarily.

Other conditions which have a superficial resemblance to myositis ossificans are spondylitis deformans, the Charcot joints in tabes, and muscular dystrophy.

PATHOLOGY.—In the early stage of the disease the intramuscular connective tissue becomes infiltrated, chiefly in the vicinity of the blood-vessels, with embryonic connective tissue, which proliferates and later develops into adult fibrous tissue. This contracts, with consequent induration of the connective-tissue mass and secondary atrophy of the muscle fibers. In the final stage the connective tissue undergoes ossification. Macroscopically, in the first stage the muscles implicated are

yellowish red in color, soft, and swollen. In the second stage the muscle becomes lighter in color, with reddish streaks representing the remaining muscle fibers, and has the consistency of a fibroma. In the terminal stage the mass takes on the hardness of bone.

Under the microscope, the muscle fibers show secondary atrophy and fatty and granular degenerative changes, with a few normal fibers remaining at the periphery. The cross-striations disappear and the sarcolemma nuclei are markedly increased. The process of ossification begins in the connective tissue between the muscle fibers, toward the center of which are seen small spaces containing the so-called "formative cells," which subsequently become osteoblasts and bone-corpuscles. These primary bony foci enlarge and later unite to form larger osseous masses which resemble true bone in every particular. Elliott (Jour. Amer. Med. Assoc., Sept. 9, 1911, No. 11, p. 873) reported a typical case of the malady and concluded that there was "no doubt that myositis ossificans progressiva is an inflammatory progressive myositis." His opinion as to the nature of the process, however, is based on the clinical course of the disease and is not confirmed by the pathological findings. Goto (Archiv für klin. Chir., Berlin, c, No. 3, 1913), in another study of the pathological anatomy of myositis ossificans, concludes that the malady is not inflammatory nor of a neoplastic nature, but due to a congenital defect in the differentiation of the connective-tissue elements. That the calcium metabolism is normal has been shown by the investigations of

Austin on a patient of Painter's (Jour. of Med. Research, N. S., xvi, 451).

ETIOLOGY.—The theories that have been advanced as to the origin of this peculiar disease are numerous and interesting. It has been considered as being of a rheumatic nature (Stonham), as a new growth (Mays, Ziegler), a trophoneurosis (Nicoladoni, Kleen, Eichhorst), and a form of atavism (Brennshon). Maunz has suggested that there is an embryonic displacement of the bone nuclei within the muscle substance. Another view, strongly advocated by Rolleston and by Elliott, is that two factors are concerned: a congenital deficiency in the resisting power of the muscles which renders them susceptible to inflammation from what would ordinarily be inadequate exciting causes, and a morbid predisposition to aberrant bony formation.

Of exciting causes, trauma is the only one that stands out at all conspicuously, although exposure to cold has been mentioned as a possible factor in some instances. Many cases develop without any apparent exciting cause.

Numerous causes of myositis ossificans have been offered, but there is no explanation of why the process showed such predilection for these two places, while all parts of the trunk and extremities are frequently exposed to wounds and contusions. It is always found near joints. The synovia forced into an adjacent broad, fleshy muscle by the trauma may be responsible for the initiation of the ossifying process. Ewald (Zeit. f. Chir., May 28, 1910).

Traumatic intramuscular ossification (myositis ossificans) is essentially the same process as callous formation. The condition may be provoked experimentally in animals by reproducing the same mechanical

conditions by an aseptic open operation. Morley (*Brit. Med. Jour.*, Nov. 29, 1913).

Case in a medical student characterized by creaking in different muscles. In the literature they found only 3 cases recorded, and theirs seems the only one in which any pathological and microscopical investigation of the lesion was made. A piece of muscle was removed from the left scapular region, where the crepitus was most marked. The findings were localized thickenings in the aponeurosis and muscle, which had been caused by hyaline swellings. The cause of this affection is over-exertion, resulting in small areas of rupture in the muscle and the aponeurosis, followed by minute hemorrhages and hyaline thickenings. These thickenings cause a creaking when the two surfaces rub together. Hoag and Soletsky (*Jour. Amer. Med. Assoc.*, March 14, 1914).

The great majority of the cases of myositis ossificans are first observed before puberty, and the largest number of these during the first few years of life. The malady has developed, however, as late as 35 years (Rogers) and 54 years (Kroneker), and as early as the fifth month (Garrod).

Males are affected more frequently than females, the ratio being about 4 to 1. According to Steiner, the disease begins at an earlier age in women than in men.

Germany and England appear to furnish the largest number of the cases, although the malady is not anywhere common.

PROGNOSIS.—The disease is chronic and progressive, with intermissions, varying from a few weeks to many years' duration, in which actual improvement may occur, only to be eventually followed by relapse. The bony tumors remain undimin-

ished once they are established. Death may result from pyemia due to infection from bedsores, from tuberculosis, or from pneumonia or other intercurrent affection.

TREATMENT.—It should be remembered that the acute attacks or exacerbations may result from trivial causes, as a slight blow or exposure; much care should, therefore, be taken to avoid such occurrences.

Medical treatment, including organotherapy, has unfortunately proved valueless, even in promoting arrest of the disease.

Excision of the bony tumors has been tried, but the operation is followed by a recurrence of the affection.

Case in which a large myosteoma was removed from the muscle of the thigh. Sixty-six days after the accident the experiences in this case, as in others on record which he reviews, show that the myosteoma developed from ossification of the connective tissue of a contused muscle. Conservative treatment is unreliable, although the ossifying process has retrogressed enough to permit satisfactory functioning in some cases. The preferable technique, however, is to take the growth out six or eight weeks after the trauma if the myositis is not complicated with ossifying peri-arthritis. This combination is particularly frequent following dislocation and spraining of the elbow. Removal of the myosteoma is of little use in such a case. **Orthopedic resection** should be applied for persisting serious infirmity. The muscle and bone tissues surrounding the myosteoma should be spared injury. Lapointe (*Revue de chir.*, Nov., 1912).

When fixation of the jaws occurs, it is sometimes necessary to **remove teeth** to facilitate feeding.

MYASTHENIA GRAVIS.

SYNONYMS.—Bulbar paralysis without pathological lesions; asthenic

bulbar paralysis; pseudoparalysis myasthenica; Erb's disease.

DEFINITION.—A disease characterized clinically by motor impairment, chiefly glossopharyngolabial, varying in degree from slight exhaustibility to complete paralysis, and pathologically by the absence of definite lesions in the nervous system and the presence of lymphocytic infiltration (lymphorrhages) in the muscles.

HISTORY.—Although myasthenia gravis is sometimes spoken of as Erb's disease, from his description in 1878 of cases presenting a bulbar syndrome, yet differing in course from chronic progressive bulbar paralysis, cases of the disease had previously been reported by other writers. Wilkes, in 1877, recorded a case, but without much elaboration. Willis and Bazire had also reported cases. It remained for Oppenheim, in 1887, to direct attention to and stimulate interest in the disease by an elaborate description, with detailed microscopical study, of a case he had observed clinically for some time. Goldflam emphasized the occurrence of oculomotor paresis and called attention to the rapid exhaustibility of muscles upon voluntary effort, while Kuh and Braude (*Jour. of Nervous and Mental Dis.*, Oct., 1913, xl, No. 10) recently observed in a case reported by them that a feeling of fatigue was produced by passive movements. Jolly, in 1895, studied the reaction of the muscles to faradic currents and found that with repeated electrical stimuli the muscular contractions would become successively weaker, but would regain their former excitability after a brief rest. He termed this phenomenon the "myasthenic reaction." Buzzard observed that muscles fatigued by the faradic current still retained their excitability for the galvanic current. Weigert was the first to describe the lymphatic muscular infiltration which has since been confirmed by numerous observers.

SYMPTOMS.—As the name indicates, muscular weakness is the chief feature of the disease. This varies from slight exhaustibility to complete

paralysis, and affects the skeletal muscles in general and those supplied by the motor nuclei in the bulb in particular. Not only does this fatigability vary in different muscles in a given case, but from time to time in the same muscles. Volitional movements or electrical stimuli cause first exhaustion, then, if continued, paresis. After an interval of rest the muscle response is again normal.

The onset of myasthenia is usually gradual, but may be more abrupt. In the latter case there may be an accompanying general malaise with headache. Oculomotor weakness is a common initial symptom, ptosis being perhaps the most frequent. Next in frequency is involvement of the muscles of mastication, articulation, and deglutition. The disease may remain limited to these muscles or even to the oculomotor group, or less frequently, or in advanced cases, the muscles of the trunk and extremities may also be implicated.

Myasthenia is clinically characterized by fatigue and exhaustion of the patient when making voluntary movements. The muscles especially involved are those which are supplied by the following nerves, viz.: trigeminus, facial, glossopharyngeal, vagus, and hypoglossus. Of chemical importance is the insufficiency of the oxidation processes, which results in the occurrence of intermediary products of metabolism, disturbance of the chemical constitution of the muscle, and augmentation of the urinary nitrogen excretion. G. Marinesco (*Semaine méd.*, No. 36, 1908).

The literature on the subject contains several erroneous views which are current regarding this disease. A majority of the reported cases have occurred between the ages of 20 and 40 years; but no age is exempt, it having been reported in patients as young as 3 and as old as 72 years.

In about one-third of the cases the first weakness noted was felt in the arms or legs, cranial nerve symptoms appearing only some time later. Headache is a common symptom to which little attention has been given. M. Allen Starr (*Jour. of Nerv. and Mental Dis.*, Nov., 1912).

The first symptom may be a drooping of the lids, appearing toward evening, and disappearing after the night's rest; as the disease progresses, some ptosis may remain even in the morning. Next, varying degrees of strabismus may make their appearance.

While the affection is usually bilateral, corresponding muscles may not be affected to the same extent. Thus one lid may droop more than its fellow, and the eyeballs may be on different planes. The irregular involvement of the ocular muscles may cause nystagmoid movements upon volitional motion of the globes. When the ptosis is marked the patient either uses his occipitofrontalis or holds his head backward in the effort to overcome the resulting difficulty in seeing. Loss of the pupillary light reflex is rare, but it is not uncommon for the iris to show exhaustion if the test is repeated. Reaction to accommodation is apt to show the characteristic exhaustion, but it may not be affected.

Of the facial muscles, the orbicularis palpebrarum is the most likely to escape. Implication of the other facial muscles causes loss of expression, drooping of the corners of the mouth, inability to whistle or blow out a lighted candle, and drooling of saliva. Difficulty in masticating and in articulating result if the muscles governing the lower jaw are affected. Difficulty in swallowing, with regurgitation of fluids through the nose, results from paralysis of the muscles of

the palate, and if the tongue is involved there is added difficulty of articulation and food is not properly removed from the mouth. From paresis of the laryngeal muscles aphonia may result.

It must be remembered that all the conditions described above may be manifest in varying degrees of intensity or severity, according to the degree of fatigability of the muscles present.

Weakness of the muscles of the neck causes difficulty in holding the head upright, patients so affected frequently using their hands as an added support. Involvement of the truncal muscles may be so extensive as to confine the patient to bed; but the chief danger results through implication of the muscles of respiration, with dyspnea and a possible fatal termination from suffocation.

The muscles of the extremities are not, as a rule, involved to the same extent as those of the face and neck. They may be affected at any stage of the disease, the proximal muscles being more frequently implicated than those more distally located. Through involvement of the muscles of the hand, writing may show the characteristic fatigue, and when the muscles of the lower extremities are affected walking obviously becomes difficult. A sudden "giving way" of the legs may be an early symptom.

All of these manifestations are apt to be slight after the night's rest, becoming progressively worse toward evening.

Conditions affecting the general exhaustibility are emotion, exposure to extremes of temperature, menstruation, and exertion, whether local or general.

Myasthenic Reaction.—The reaction of the affected muscles to electrical stimulation is characterized by the following phenomena: There is a gradual diminution in the muscular response to faradic shocks of a given strength, from strong contraction at first to complete failure to respond after repeated stimulation. After a brief rest the original strength of reaction returns, only to diminish progressively again, and more rapidly than before, in response to further stimulation.

Muscular reaction to the galvanic current is unchanged or but slightly diminished in myasthenia. An interesting phenomenon, however, is that after a muscle is exhausted by and fails to respond to the faradic current it will still react to the galvanic current (Murri) and to voluntary effort.

In muscles that have actually undergone atrophy, the reaction of degeneration has been observed (Buzzard).

Tendon Reflexes.—These are preserved even when the corresponding muscles are exhausted, but may be diminished in advanced cases. Ankle clonus and Babinski's sign are absent, irritation of the sole of the foot being followed by the normal flexion of the great toe.

Sensation.—In an uncomplicated case of myasthenia sensory disturbances are absent or limited to paresthesiæ, or an aching or slight pain in the extremities.

Sphincters.—The functions of the bladder and bowels are, as a rule, unaffected, although in rare instances slight urinary incontinence has been observed.

Psychic Symptoms.—It may be said that in myasthenia the mind is un-

affected, although cases have been reported in which there has been a coincident melancholia.

Urine.—A diminution in the amount of creatinin excreted has been observed (Spriggs), while the amount of uric acid eliminated is unchanged.

DIAGNOSIS.—While the infrequency of myasthenia gravis may cause it to be overlooked, the purely motor character of the disease which affects primarily and chiefly the muscles supplied by the bulbar nuclei, the characteristic exhaustion without paralysis in the affected muscles, the myasthenic electrical reaction, and the absence of fibrillation, atrophy, and the reactions of degeneration form a combination that should offer no difficulty in recognition if borne in mind.

In chronic poliœncephalitis there is distinct muscular wasting, with reactions of degeneration, or at least diminished response to electrical stimuli. There is also fibrillation, and the course is not marked by remissions.

Pseudobulbar palsy gives a history of two or more apoplectic attacks; the upper part of the face is uninvolved, and signs of upper motor segment lesion are present.

Multiple neuritis in general and diphtheritic paralysis in particular offer a superficial resemblance, but there is a definite history of cause and onset and a different response to electrical tests.

In advanced cases of neurasthenia the exhaustion is marked, but neurasthenics are notoriously worse in the morning and at their best in the evening.

Hysteria may present the same irregular remissions and exacerbations in its course, but hysterical

palsies of the face are rare, and the associated sensory "stigmata" of hysteria are usually conspicuous.

The resemblance of certain cases of muscular dystrophy to myasthenia has been commented upon by Gowers, Oppenheim, and others, but in the former affection there are marked muscular atrophy, an absence of the myasthenic reaction, and an absence of involvement of the muscles of deglutition.

Myasthenic symptoms are not uncommon in many different diseases, especially various organic nervous diseases. The frequent association of perverted conditions of the ductless glands in such conditions is significant. Pearce Bailey (N. Y. Med. Jour., June 8, 1912).

PATHOLOGY.—The most constant and characteristic finding in myasthenia gravis is an infiltration of small round mononuclear cells (lymphocytes), chiefly in the muscles, but also in other tissues and organs.

Since Weigert's original observation of this condition in 1901 (Laquer and Weigert: Neurol. Centralbl., 1901, xx, 595) the finding has been repeatedly verified. Knoblauch in 1908 found the "lymphorrhages," as they were termed by Buzzard, in portions of muscle studied *ante mortem* from a case of myasthenia gravis.

The cellular accumulations vary in size from the smallest possible number to collections large enough to be distinguished by the naked eye in a stained section (Buzzard). They are found between the muscle fibers, which in rare instances are involved by the cells. Some observers have found slight degenerative changes in the muscle fibers thus involved, but everywhere else the fibers are, as a rule, unchanged. A serous exudate

and minute capillary hemorrhages have also been seen. In the larger collections of cells a delicate reticulum is found, giving an appearance closely resembling lymphoid tissue. Slight muscular atrophy is an exceptional finding.

In the nervous system lymphorrhages have been found in isolated instances in the posterior root ganglia of the cord and in the medulla. Kuh and Braude recently reported the occurrence of an aberrant bundle of fibers in the cervical region of the cord, but this was probably an anomaly, comparable with the micrognathia, polydactyly, and doubling of the great toe observed in cases by Oppenheim and upon which he placed considerable importance as indicating a probable congenital predisposition, a view not held by most writers. Numerous minor findings have been recorded, such as recent hemorrhages, excess of glial tissue, capillary thrombi, and chromatolytic and pigmentary changes in nerve-cells; but these are not held to have any special significance. The striking feature of repeated examinations of the nervous system in myasthenia gravis by competent observers has been the universal absence of any characteristic lesion.

In a typical case of myasthenia gravis in a physician 50 years of age, of a duration of about five years, examination of the nervous system showed small areas of vascular sclerosis, recent (agonal?) hemorrhage, increase of glia tissue, and corpora amylacea in the spinal cord. In the cervical region there was an aberrant bundle of fibers. In the higher levels of the cord capillary polymorphonuclear thrombi and chromatolytic and pigmentary changes were seen in the nerve-cells. The

relative intensity of these latter findings remained approximately constant, *i.e.*, where the thrombi were numerous, the changes in the nerve-cells were greater. The same applied to medulla and corpora quadrigemina. In the cortex there was but little of these changes to be seen; more in the optic thalami. The muscles showed nothing that had not previously been described. Sidney Kuh (Med. Record, July 19, 1913).

Next in frequency to the muscular system, morbid changes have been found in the thymus gland. Buzzard divides these conditions into three classes: (1) Simple hypertrophy, where the gland has not undergone the usual regressive changes; (2) hypertrophy with degenerative and proliferative changes, and (3) new growth, including such conditions as lymphosarcoma and lymphangi endothelioma. It must be remembered, however, that the majority of cases present no thymus abnormalities.

Lymphorrhages have been found in the thyroid gland, adrenals, liver, and pancreas, and in one instance (Tilney) there was an adenoma of the hypophysis.

Moderate lymphocytosis of the cerebrospinal fluid has been observed. The urine and blood have been examined with negative results.

When the data regarding the pathogenesis of any disease are meager, hypotheses are numerous, and myasthenia gravis is no exception to this rule.

The disease has been variously considered as a neurosis (Oppenheim), as due to faulty hepatic metabolism (Kauffmann), and as the result of hyperparathyroidism (Chvostek). Buzzard suggested that an unequal functional activity of the muscle elements,

that of the sarcoplasmic fibers being diminished, could result in the rapid exhaustion of the red muscular fibers. Knoblauch advocates the theory that there is an increase of the pale and a diminution of the red fibers. McCarthy cites the work of Botazzi and Joteyko and their contention that in muscles there are two contractile substances, a fibrillar and a protoplasmic, which respond differently to electrical stimuli, and offers the theory of a selective poison reducing the excitability of the protoplasmic element.

That some toxin as yet undiscovered is responsible for the curious clinical manifestations of myasthenia is the general belief. The idea of an exogenous toxin is advocated by some on account of the numerous instances recorded in which myasthenia has followed an acute infection. The weight of evidence, however, seems to favor an endogenous toxin resulting from a defect of internal secretion.

ETIOLOGY.—Myasthenia gravis occurs in the two sexes with nearly equal frequency, females slightly predominating. The majority of cases occur in the third and fourth decades, although cases have been reported under 10 and over 60 years. McCarthy (Osler's "Modern Medicine," 1909, vol. vi, 607) has shown that in women the disease appears at an average earlier age than in men.

The disease is neither hereditary nor familial. Indirect neuropathic heredity also seems to play an unimportant rôle. Oppenheim emphasizes a congenital predisposition and cites a list of congenital anomalies that have been observed in his own and other reported cases.

The onset of myasthenia gravis has followed acute infectious diseases in

a considerable percentage of cases, influenza being the most frequent. Other preceding infections have been typhoid fever, diphtheria, scarlet fever, puerperal infection, and syphilis. There is nothing to indicate a direct relationship between myasthenia gravis and syphilis, tuberculosis, or alcoholism.

Numerous observers have recorded cases of myasthenia gravis in association with exophthalmic goiter, but, while this relationship is certainly more than coincidental, its significance is as yet unexplained. In isolated instances the disease has been found associated with Banti's disease (S. Mohr) and with angioneurotic edema (Diller).

Pregnancy, lactation, and menstruation usually have a deleterious effect on myasthenia gravis, although there have been exceptions to this rule, notably in a case reported by Goldflam.

When so many and so varied conditions are mentioned in connection with the etiology of a disease it is obviously difficult to select any one as being of chief importance, and to add still further to the obscurity Gowers has reported a case of myasthenia gravis occurring after poisoning by petrol fumes, and Buzzard one following poisoning from coal gas.

PROGNOSIS.—Myasthenia gravis is a serious and uncertain affliction. It may run an acute course and terminate fatally in a few weeks, or may last for years. Some few cases recover; remissions are of common occurrence, and fatal termination is frequent.

TREATMENT.—In the treatment of myasthenia the first consideration is the avoidance, as far as possible, of

factors known to aggravate the condition. The patient should have **rest** and **quiet**, preferably in bed, and should be **kept warm**. The food should contain a **maximum** of **nourishment** and require a **minimum** amount of **mastication**. Feeding by the stomach-tube is not to be advocated unless deglutition becomes extremely difficult, as the act of passing the tube is accompanied by both emotional excitement and muscular effort in the attempt by the patient to swallow the tube. This is pointed out by Oppenheim, who mentions a case that died from suffocation during an attempted artificial feeding.

Electrical stimulation of the muscles by the faradic or galvanic current is contraindicated. **Central galvanization** is recommended by some, but the most that can be said of this form of treatment is that it does not seem to have caused any harm. **Massage**, if used at all, must be practised carefully, as it is capable of doing harm. Extracts of the various ductless glands have been used, but, as a rule, without favorable results.

Arsenic, **iron**, and **strychnine** may be used, more in the hope of improving the patient's general condition, however, than with any expectation of arresting the disease.

In myasthenia gravis there may be marked loss of calcium by the tissues even under circumstances of marked nitrogen retention. The creatinin output may be reduced to a point below normal; the output of creatin nitrogen expressed in percentage of the total urinary nitrogen may be almost as low as that seen in conditions of true muscular wasting. These facts taken together form a reasonable basis for belief that myasthenia gravis is a disease of deranged muscular metabolism, and that one

at least of these two factors (that is, the loss of calcium) may stand in such a causal relationship as to indicate the therapeutic administration of that element. Ralph Pemberton (*Amer. Jour. Med. Sci.*, June, 1910).

The writer first prescribed thyroid extract with very bad results, but considerable improvement followed exhibition of 5 Gm. (75 grains) of **thymus extract** thrice daily. Use of thymus extract was suggested by the theory that the disease was due to some affection of the thymus gland. A. McLane Hamilton (*Jour. Amer. Med. Assoc.*, May 25, 1912).

Pituitary extract, combined with **ovarian**, found useful in 2 cases. Lagane (*Presse méd.*; *Charlotte Med. Jour.*, Nov., 1913).

In a study of 2 cases the writer lays special emphasis on **timing deglutitions** while eating, to give the weakened muscles a short interval for recuperation, *e.g.*, 2 to 4 minutes. The food should be such as to be easily masticated. The patient should not drink from a cup or glass, but with a spoon to avoid choking and perhaps bronchopneumonia. Monrad-Krohn (*Norsk. Mag. for Lægevid.*, May, 1918).

MYOTONIA CONGENITA.

SYNONYM.—Thomsen's disease.

DEFINITION.—A congenital disease the chief feature of which is an interference with voluntary movement by reason of stiffness of the muscles.

HISTORY.—The first detailed description of this disease is ascribed to Thomsen, a Danish physician, in 1876. Thomsen was himself a victim of the malady, which had appeared over twenty times in four generations of his family.

SYMPTOMS.—When the patient attempts to make a voluntary movement, the muscle groups involved go into a state of tonic contraction. This retards the intended movement for some seconds; then the muscles relax slowly until the movement can be consummated. With repetitions

of the movement, each successive effort is performed more easily, the stiffness gradually disappearing until the movements are made without difficulty. After an interval of rest, the spasm reappears when the movement is again attempted.

Excellent examples of the curious phenomenon are seen in sudden attempts of the patient to clench the fist or to walk. In advanced cases, upon a sudden attempt at movement when the patient has been quiet or, as mentioned by White (Allbutt and Rolleston, "*System of Medicine*," vol. vii, p. 27), if he trips against a stone while walking, he may fall and be rigid and helpless until the muscles gradually relax.

The malady usually involves the majority of the voluntary muscles to some extent, but this involvement may vary greatly in intensity in different parts of the body. It is not uncommon to find the upper or lower extremities profoundly affected and the face undisturbed. Next in frequency and extent to the involvement of the extremities is that of the truncal muscles. The muscles of the head and neck are frequently affected, those of the face less often. The ocular muscles are sometimes implicated; likewise the tongue. Oppenheim cites a case in which the orbicularis palpebrarum alone was distinctly affected. The pharyngeal and laryngeal muscles are among those least apt to be involved, and the respiratory muscles are also rarely implicated. Swallowing and respiration therefore are not affected, and the same is true of the acts of micturition, defecation, and parturition.

The affected muscles are large, well developed, sometimes enormous,

but notwithstanding their large size the actual strength, as shown by the dynamometer, is, as a rule, below normal.

General fatigue and emotion appear to aggravate the condition, which is also more marked after a long rest. **Warmth** and **mental rest** appear to exert a beneficial influence.

Electrical Reactions.—These have been termed by Erb the “myotonic reaction” (My R) and are as follows: The excitability of the nerves to the faradic current is normal, with the exception that a strong current causes a persistent tonic contraction of the muscle. When the galvanic current is applied to a muscle it responds promptly and about equally to both K. C. C. and A. C. C., the latter sometimes giving the stronger reaction. A characteristic feature is a slow, tonic contraction with reluctant relaxation, the contraction lasting several seconds when a strong current is applied. Application of the stable galvanic current causes a wave-like undulation of the muscle, the wave passing from the cathode toward the anode. This last reaction is not always easily obtained, requiring rather large electrodes and a strong current. Reaction of the muscles to the static spark is unaltered (Oppenheim).

The **mechanical excitability** of the muscles is not increased, but tapping the muscles will give the characteristic slow, tonic contraction, persisting for some seconds. There are no sensory changes and pain is absent, even during the tonic muscular contractions.

The **reflexes** are usually normal, but there may be a diminution of the knee-jerk. In rare instances this reflex has been lost. The blood-pres-

sure has been found increased (Guillain).

An association of the disease with migraine and epilepsy is not uncommon, and mental symptoms have also been recorded as a complication of myotonia.

Association with other states has been frequent and the associated conditions numerous and varied, but with the exception of those mentioned and of myopathy (Charcot, Nonne) they do not seem to be of any importance.

The writer, a sufferer from the disease, is convinced of the important rôle played by the nervous system. Too little stress has been laid on other neuroses in the different family groups. In his own case, one sister, deceased, showed it in a severe general form, one suffers from traces of it and two male maternal cousins also suffer from it; the nervous element predominates in the family. As regards prognosis, two points are of importance: First, the earlier in youth the diagnosis is made, the more important is the choice of an occupation; and, second, the subjects are in more than ordinary danger of accident, as the sudden movement to get out of harm's way is often impossible. In treatment nothing has proved of any avail. A. Birt (*Montreal Med. Jour.*, Nov., 1910).

The belief that progressive muscular atrophy may develop from myotonia is held by Hoffmann and others.

DIAGNOSIS.—The peculiar clinical picture presented by Thomsen's disease, together with the “myotonic reaction,” make the malady easy of recognition. Myotonia acquisita, described by Talma, presents an increased excitability of the muscles to electrical and mechanical stimuli, but is an acquired affection, transient and curable. The spasms come on chiefly

after exertion and the muscular rigidity is retained to some extent after rest.

In Eulenburg's paramyotonia congenita the myotonic reaction is absent and the muscular spasms are induced by cold.

PATHOLOGY. — Microscopically changes are found in pieces of the muscles excised during life. The fibers show marked hypertrophy, being twice as large as normal, or even larger; there is an increase in the number of the sarcolemma nuclei and possibly a slight increase of the interstitial tissue. The cross-striations are not clearly defined. The same changes have been found *post mortem* (Déjérine and Soltas). Vacuolation has been observed, but it is not a constant finding. No pathological changes have been found in the nervous system.

That the disease is congenital is well established by its occurring in several members of the same family, and the very early appearance of the symptoms strongly suggests an anomaly of development of the muscle fibers. The theory of a toxic origin has been suggested by the fact that corresponding symptoms have been produced by certain poisons (Joteyko, Bechterew).

In a family with a history of marked von Graefe sign for five generations this sign is so evident that it is considered by the family the most interesting manifestation of the condition, and the underlying myotonia had gone undiagnosed through several generations. The family is of the oldest New England stock. Of the 29 members recorded, 13 were affected with myotonia and 16 were free. All of those affected showed the von Graefe sign to a greater or less degree. Of the af-

ected, 7 are males and 6 are females, a fairly equal division. Sedgwick (Amer. Jour. Med. Sci., July, 1910),

ETIOLOGY.—No cause of the disease is as yet known. It appears usually in earliest childhood, but may remain latent until adolescence. It is more frequent in males than females (8 or 9 to 1). Fright has preceded the onset of the malady, but not to the extent that it can be given any value as an etiological factor.

Heredity plays an important role, the disease almost invariably appearing in several members of a family, brothers, sisters, parents, uncles, aunts, etc. While other neuroses and psychoses have appeared in the families of some of the reported cases, they are so commonly absent as to deprive their occurrence of any special significance. Consanguinity in the parents has been noted in some cases.

There is evidence that thyroparathyroid deficiency is etiologically related to myotonia congenita. Myasthenia is frequently associated with hyperthyroidism, hypoadrenalism, and probably with hyperactivity of the thymus. Hyperthyroidism and findings suggesting both hypo- and hyperactivity of the thymus have been noted in amyotonia. Myopathy has been found with many endocrine disorders, perhaps oftenest with hypopituitarism. Thyroid and thymic hyperfunction are frequently observed in hypopituitarism. McCouch and Ludlum (Med. Rec., June 10, 1917).

PROGNOSIS.—The disease of itself is never fatal, but, once having made its appearance, the malady exists throughout the life of the individual. It shows no tendency to progress, neither does it disappear, although remissions may occur. According to White, the stiffness is somewhat more marked at puberty.

Myotonia atrophica might be regarded as a muscular atrophy of a myelopathic origin, but the distribution of the atrophy is strongly against such a view. The condition might be regarded as a myotonia congenita (Thomsen's disease), and some authors have regarded these cases as aberrant forms of that disease. The weakness of the facial muscles and the character of the articulation may suggest the presence of myasthenia gravis, and some cases have been so described. The muscles do not respond readily to the faradic current; nor do they, however, show the myasthenic reaction. From the various types of myopathy it is by no means easy to distinguish this group, for features are present which very closely resemble the facioscapulo-humeral type of Landouzy and Déjérine, and also the "distal" type; the presence of the myotonic symptoms should separate such cases from these groups. In conclusion, he summarizes the leading features as follows: A patient, usually a male, between the twentieth and thirtieth year of life, begins to complain of weakness of the limbs and wasting of muscles. Some stiffness of muscles may also be complained of. On examination he is found to have weakness and atrophy of the facial muscles, of the sternomastoids, of the flexors and extensors of the wrist, of the extensor of the leg or dorsiflexors of the foot, and the striking myotonic phenomenon that after grasping an object he has difficulty in relaxing his grasp. Pathologically there is a general cirrhotic condition of the muscles, such as is found in muscular dystrophy. The spinal cord may show some degeneration in the posterior columns, but the other portions of the nervous system are normal. When once seen the condition is easy of recognition. That variations from this clinical picture have been and will in future be described is certain, but the name "*myotonia atrophica*" will serve as a point around which this type of case

may be collected and investigated. Batten (Lancet, Nov. 20, 1909).

Case of *myotonia atrophica* in which the patient's method of rising from the recumbent position resembled that met with in pseudohypertrophic paralysis. The right vocal cord was fixed midway between the cadaveric and phonatory positions. There was no evidence of any lesion of the vagoaccessory nerve, either centrally or peripherally. Fox (Jour. Laryn., Rhin., and Otol., Dec., 1909).

Two cases of *myotonia atrophica* reported in this country prior to this paper and it is a rare disease everywhere. There is apparently a frequent tendency for it to take on familial characteristics, but this is not constant and was not observed in either of these 2 reported cases. Neither of the patients had, as far as learned, any neuropathic heredity or antecedents, though one of them was a Russian Jew. In the second case the symptoms of the disorder were preceded by an accident, according to the history given. The first case conforms exactly with the clinical picture drawn by Batten and Gibb, but in the second case there occurred in addition an intense muscular weakness and premature bilateral cataract. Kennedy and Oberndorf (Jour. Amer. Med. Assoc., Sept. 30, 1911).

Report of a case of *myotonia atrophica*. The combination of premature bilateral cataract with atrophy of the temporal, orbicular, masseter, sternomastoid, vasti, and anterior tibial muscles, together with a sharply contrasted myotonus in the hands, occurs too frequently to be ignored and most probably points to a deficient hereditary endowment as the approximate cause of the disease. Foster Kennedy (Jour. Amer. Med. Assoc., Nov. 29, 1913).

TREATMENT.—Nothing is known that will cure the disease, and drugs avail nothing toward relief of the symptoms. **Systematic gymnastics**, as

first advocated by Oppenheim, have proved of some value. Gessler's suggestion of stretching the nerves to produce atrophy of the muscles is only mentioned that it may be condemned.

AMYOTONIA CONGENITA.

SYNONYMS.—Oppenheim's disease; myatonia congenita.

DEFINITION.—A disease appearing in early childhood, characterized by a flaccid paralysis with diminished or lost tendon reflexes, but without reactions of degeneration or marked muscular wasting.

SYMPTOMS.—The most conspicuous feature is the striking flaccidity of the affected muscles manifested at birth or shortly thereafter. The lower extremities are always affected, sometimes the upper extremities, and less frequently the trunk. The muscles of the face and the diaphragm usually escape, while the ocular muscles and those of mastication and deglutition are not involved. Active movement is not entirely lost, but greatly restricted, and the child appears as if paralyzed. So great is the degree of hypotonia that the extremities may be moved about like flails, and when unsupported the child presents a kyphotic deformity, owing to relaxation of the truncal muscles. This disappears when the child is raised by the shoulders. Contractures may occur.

Reaction of the muscles to the faradic current is diminished or lost, but reaction to the galvanic current is normal. The tendon reflexes are invariably lost, but return as the patient improves. Sensation is not altered and the sphincters are unaffected. The mentality is normal.

In an extreme case observed by the writer the head was thrown backward as in severe opisthotonos, the mouth constantly wide open, but there was no paralysis. At times there was transient contracture of certain groups of muscles. This alternation of extreme relaxation with a tendency to transient contracture differs from the typical Oppenheim disease, and still more from the type that has been described as the tetaniform type of Little's disease. L. Guinor and Gauducheau (*Bull. de la Soc. de Pédiat.*, Oct., 1911).

The writers noted hepatic deficiency shown by acholia, normal calcium but relatively high potassium retention, a low creatinin excretion, and a relatively high creatinin excretion. The use of bile salts or dried ox bile caused an increase in muscular strength and restored in part the normal ratio of the potassium to calcium retention. Powis and Raper (*Quarterly Jour. of Med.*, Oct., 1916-Jan., 1917).

DIAGNOSIS.—The early onset, the extreme flaccidity, and the absent tendon reflexes and characteristic electrical reactions should render the diagnosis a comparatively simple one.

Myopathy appears at a later period, occurs in definite muscle groups, is progressive, and shows distinct muscle atrophy. Amyotonia never progresses, but usually improves, and there is no family tendency as in myopathy.

Obstetrical palsies are generally unilateral; amyotonia is symmetrical.

Infantile paralysis gives the history of an acute onset, with usually some constitutional symptoms followed by abrupt loss of power in one or more of the extremities. The reactions of degeneration are present in the majority of instances.

PATHOLOGY.—The muscles, while not visibly atrophied, are small and yellowish in color, and an un-

usual amount of fat is seen between the muscle bundles. Microscopically, the majority of the muscle fibers are much smaller than normal, while interspersed here and there between the smaller fibers are found fibers with a size greater than the normal. The small fibers may show a marked increase in the number of the sarcolemma nuclei, or may have only the usual number. The cross-striations are distinct, and there are no degenerative changes. The large fibers also show well-marked cross-striations and have the normal number of nuclei, but show distinct regressive changes, such as centric displacement of the nuclei, vacuolation, and longitudinal cleavage of the fibers. In the affected muscles there is a marked increase of connective tissue.

In the nervous system the motor cells of the anterior cornu of the cord are reduced in number and there is also a diminution in the number of fibers in the anterior nerve-roots, which are small and deficient in myelination. Fibrosis of the thyroid and thymus glands has been reported (Spiller).

In the lighter cases the alteration may be confined to the muscles, and possibly, therefore, the disease is primarily muscular, but this inference is not fully warranted. In the intense cases the nervous system is affected in marked degree. The relations to muscular dystrophy are as yet undetermined. Griffith and Spiller (*Amer. Jour. Med. Sci.*, Aug., 1911).

Oppenheim believed that the malady was the result of delayed development of the muscles and possibly also of the anterior horn cells. Holmes and Collier hold that the changes differ from those of developmental

arrest and consider them as regressive lesions, while Cattaneo advances the theory of a perverted internal secretion.

ETIOLOGY.—This has not been determined. The disease appears during the first few years of life, being congenital in the majority of cases, though not familial. The two sexes are affected about equally. Cases have been reported in association with myopathy (Sylvestri), and the disease has in a few instances followed an acute infection, such as bronchitis. Signs of physical or mental arrest at birth have been absent.

Two cases with necropsy findings in one compared with similar cases on record. Everything seems to suggest that the condition is the result of an acute poliomyelitis affecting the fetus and leaving its unmistakable traces. Besides the histological findings is the fact that poliomyelitis was epidemic in Vienna at the time one of the children was born. O. Marburg (*Arbeiten a. d. interacad. zentralinst. f. Hirnforschung*, Bd. xix, No. 2, 1912).

PROGNOSIS.—The disease tends toward gradual improvement without complete recovery. Progress is most marked in the muscles least affected.

Implication of the respiratory muscles may lead to a fatal termination.

TREATMENT.—Tonics, such as iron, quinine, and strychnine, are recommended. The nutrition of the affected muscles should be stimulated by **massage and passive movements**.

Braces or mechanical appliances of any sort are contraindicated, and the child should be encouraged to help himself as much as possible.

In one of the author's cases symptoms referable to both the myotonia congenita of Oppenheim and infantile muscular atrophy, as described by

Werdnig and Hoffman, were present, and, in addition, optic atrophy, hitherto never observed, was found in pronounced form.

The presence of a malformed cranium and positive Wassermann reaction suggested congenital syphilis as the cause of nutritional disturbance in the anterior horn cells in this case; large doses of **iodides**, furthermore, proved beneficial. In a second case, more of the type of infantile muscular atrophy than myotonia congenita, iodides caused but very little improvement. A. Gordon (*Monthly Cyclo. and Med. Bull.*, April, 1913).

MYOPATHY, OR MUSCULAR DYSTROPHY.

SYNONYMS.—Idiopathic muscular atrophy; primary myopathy; progressive muscular dystrophy.

DEFINITION.—Under the general heading myopathy are included a number of forms or types of muscle disorder, frequently hereditary or familial, having in common an onset at an early age, atrophy, and the absence of fibrillary tremors and reactions of degeneration. The atrophy may be associated with true hypertrophy or pseudohypertrophy.

The appearance of two or more of the different types of myopathy in the same family, and the occurrence of transition forms of the disease, establish the unity of the entire group.

HISTORY.—To Meryon, from a published report of a case with necropsy in 1852, belongs the credit of ascribing pseudohypertrophic paralysis to a primary disease of the muscles, although the first authentic clinical description was made by Bell in 1830. Duchenne, in 1868, was the first to use the term "pseudohypertrophic paralysis." The juvenile form was so designated by Erb in 1882, and the facio-scapulohumeral type was described in 1884 by Landouzy and Déjérine.

SYMPTOMS.—The onset of the disease is gradual, an awkwardness in walking being usually the first symptom noted. The child falls readily and rises with difficulty. Ascending the stairs becomes difficult or impossible. Later a change in the size of the muscles is noted, consisting of either an increase or a diminution. In either case the alteration in size of a muscle is associated with a diminution of its power, and muscles primarily enlarged may later show atrophy. The extremities, especially the proximal portion, and the trunk are commonly affected, and, while the malady is bilateral, it is not always symmetrical. In the upper extremity the muscles of the shoulder-girdle, including the deltoid, trapezius, pectoralis major (sternocostal portion), latissimus dorsi, serratus magnus, rhomboids, and infraspinatus, are involved. Next in frequency follow the anterior arm muscles, the biceps, and the brachialis anticus. The supinator longus is also frequently affected. In the trunk the erector spinæ are often involved, the abdominal muscles less frequently. The pelvic muscles are apt to be wasted, and in the lower extremity the flexors of the hip, quadriceps and adductors of the thigh, the calf muscles, and the peroneal group usually suffer.

The shoulder-blades are apt to become abnormally mobile ("loose shoulders"), riding upward and flaring out from the back. As pointed out by Brissaud, there is an apparent lengthening of the neck from the drooping of the shoulders.

*Curvature of the spine is at times a conspicuous symptom. Lordosis may occur as the result of weakness

of the muscles, which produce extension at the hip, causing a tilting forward of the pelvis and a compensatory throwing backward of the upper part of the trunk to keep the center of gravity over the feet. The lordosis disappears when the patient is seated, the pelvis then resting on the tubera ischii. Lordosis may also occur as the result of wasting of the abdominal muscles, and scoliosis may develop from unequal weakness of the spinal muscles.

The child walks with a curious waddling gait, owing to the weakness of the extensors of the hip, and has great difficulty in ascending steps, because of the weakness of the extensors of hip and knees. When seated he rises by helping himself with his arms, placing his hands on his knees or thighs. If placed on his back on the floor he first rolls over on to his abdomen, then brings himself to a kneeling position by the aid of his arms, and next into a stooping position with his hands on the floor. He then straightens his legs and brings them toward the vertical by pushing backward with his hands, gradually bringing them closer to his feet. When this is accomplished he places one hand on the corresponding knee and with the other hand still on the floor pushes with both until he gains sufficient extension of the hips to enable him to place both hands on his knees, after which it is a simple matter to bring the trunk upright. This process of "climbing himself" is very characteristic of the condition.

The face is sometimes affected, causing the patient to have a rather vacuous or somnolent expression. Weakness of the orbicularis palpebrarum may cause difficulty in clos-

ing the eyes, and wasting of the orbicularis oris causes drooping of the lower lip and apparent pouting—the so-called "tapir snoot."

Deformities from permanent changes of joint position constitute a late and distressing group of symptoms. Contractures result from the action of normal muscles unopposed by the wasted antagonists.

Electrical reactions show only a quantitative reduction in excitability of the wasted muscles to both faradic and galvanic currents. Reactions of degeneration do not occur in myopathy.

The knee-jerk is normal, diminished, or absent, according to the degree of involvement of the knee extensor muscles.

Sensation is normal and the sphincters never involved. Fibrillation is only rarely observed. Arrested mental and physical development are occasionally found in association with myopathy. Congenital bony anomalies and osseous atrophy have been observed in rare instances.

Various forms of myopathy are recognized. The *juvenile type*, or brachial form of Erb, attacks chiefly the muscles of the shoulder and upper arm and appears most commonly in the older patients.

The *infantile form*, or facioscapulo-humeral type of Landouzy-Déjérine, affects primarily the muscles of the face, shoulder-girdle, and arm.

The *pseudohypertrophic form* is characterized by a false hypertrophy of some muscles, combined with atrophy in others.

Primary atrophy is usually limited to the muscles of the upper half of the body. It is, however, extremely rare for any of the muscles of the

face to be involved, and the same is true of the neck muscles. Gowers states that he has seen wasting of the clavicular portion of the sterno-mastoid.

In the upper extremity, in addition to the infraspinatus, the supraspinatus may be hypertrophied, and not infrequently the deltoid. The pectoralis major is never enlarged, but it is common to find it atrophied in its lower half. The latissimus dorsi and teres major may also show wasting. The biceps and triceps are sometimes enlarged, but more frequently atrophied. Muscles of the forearm rarely show any change, and the intrinsic muscles of the hand are almost never involved, the condition presenting in this respect a marked contrast to progressive muscular atrophy of spinal origin.

Of the truncal muscles the lumbar group generally present some enlargement. In the lower extremity, flexion of the hip is usually so distinctly affected as to indicate weakness of the flexor muscles of this joint. The muscles of the calf (gastrocnemius and soleus) are most frequent among those showing hypertrophy. The anterior tibial muscles are sometimes, but not usually, enlarged.

The muscular dystrophies, or myopathies, beginning in early life, a hereditary or familial history is common. The atrophy begins, as a rule, in the proximal portion of the limbs and in the trunk. The groups of muscles affected do not correspond with the spinal grouping of the lower motor neurons. Hypertrophy or pseudohypertrophy may be found along with muscular atrophy. The electrical responses are diminished in proportion to the amount of muscular wasting. There is no sensory

disturbance. The tendon reflexes are diminished or lost in proportion to the degree of atrophy of the muscles involved. The organic reflexes are not affected. Fibrillary tremors are not present. Craig (Dublin Jour. Med. Sci., June, 1912).

DIAGNOSIS.—In a typical case the age of the patient, the peculiar waddling gait, the difficulty in ascending stairs, and characteristic manner in rising from the floor, in association with wasting of the muscles unaccompanied by fibrillation or reactions of degeneration, should afford an easily recognizable picture.

Congenital spastic paraplegia bears a superficial resemblance to pseudohypertrophic paralysis in the gait, the weakness of the legs, and the enlargement and contraction of the calf muscles. In the former affection, however, the reflexes are increased, Babinski's sign is present, and the legs are markedly spastic.

Infantile palsy has an abrupt onset, is not progressive, and has the electrical reactions of degeneration. It is from the simple atrophic form of myopathy, rather than the pseudohypertrophic form, that a diagnosis would have to be made, as there would be no muscle enlargement in poliomyelitis.

Muscular atrophy following polymyositis presents no pseudohypertrophy, although the electrical irritability of the muscles would show the same quantitative diminution. In polymyositis there would also be a history of pain in the early stage of the affection.

The distinguishing marks of peripheral neural atrophy of the thenar muscles are: 1, Precise limitation of atrophy and motor defect to the opponens pollicis, abductor pollicis, and superficial head of the flexor brevis

pollicis; 2, reactions of degeneration confined to these muscles; 3, absence of subjective sensory changes; 4, absence of objective sensory defect; 5, absence of fibrillary twitchings; 6, rather rapid onset of atrophy and weakness. Donley (*Jour. Amer. Med. Assoc.*, April 29, 1911).

It is necessary to suspect cases in which there are early loss of power and wasting in the muscles,—especially in children,—whether running a rapid or slowly progressive course. All alterations in the contour of the limbs or changes in gait or other movements, particularly when not preceded or accompanied by other symptoms, should arouse suspicions of myopathy or myelopathy. Scratchley (*N. Y. Med. Jour.*, Feb. 7, 1914).

The writer emphasizes: (1) the early onset; (2) the atrophy of the muscles above the pelvic girdle; (3) the pseudohypertrophy of the muscles below the pelvic girdle; (4) the pseudohypertrophy of calf muscles. Frantz (*Med. Times*, xiv, 279, 1917).

PATHOLOGY.—The diseased muscles are pale yellow in color and, as Gowers long ago pointed out, resemble masses of adipose tissue. Under the microscope are seen both atrophied and hypertrophied muscle fibers, with a marked infiltration of fat tissue between the fiber bundles.

Indeed, in some instances the relation is reversed, the bulk of the mass being adipose tissue with small bands of muscle fibers seen scattered here and there through the fat. The fibers may show vacuolation, granular degeneration, occasionally waxy degeneration, and the cross-striations may be faint. There is an increase of the muscle nuclei and the fibrous interstitial tissue is often greatly augmented. Such changes as have been found in the nervous system have been inconstant and probably accidental, the anterior horn cells of the

cord and the motor nerves being invariably normal.

There seems to be no doubt that the muscles waste because of a congenital anomaly of development. In this connection Gowers calls attention to a form of congenital tumor—myolipoma—a section of which is almost identical with a section from a diseased muscle in pseudohypertrophic paralysis.

Case of pseudohypertrophic muscular dystrophy which, the writer believes, supports the view held by others as well as by himself that there may be transitional forms of dystrophy in which alterations in the nervous system go hand in hand with diseases of the muscles. Potter (*N. Y. Med. Jour.*, Aug. 28, 1909).

The pathological findings of the more recent investigations in the peroneal type of muscular atrophy have been degeneration of peripheral nerves, muscles, and posterior columns of the cord; some have found lesions both of the posterior horns and the anterior horns, and a few have observed a hypertrophy of the interstitial substance of the nerves. Muscular atrophy is by no means unknown in unequivocal cases of *tabes dorsalis*. As to sex frequency, it is usually said that males are more frequently affected than females as 5 to 1, but in the case of the family described that does not appear to be the case; indeed, the heredity seems to follow the rule in certain other nervous disorders of transmission, from the mother to the son, and the father to the daughter. A. Whiting (*Med. Press and Circular*, Jan. 27, 1909).

True degeneration of the muscle with loss of its transverse striation is met with only in general injuries draining or poisoning the organism. Lewy (*Berl. klin. Woch.*, Nov. 7, 1910).

Case of Erb's juvenile type of muscular atrophy in which the

autopsy, after tuberculosis had caused the death of the patient, showed marked differences in the degree of myopathic involvement of the several portions of the same deltoid muscle, in spite of the fact that no anomaly in the distribution of the circumflex nerve could be found accounting for these differences. All nervous structures examined, including the cord, were found normal. These findings are cited by the author in support of the muscular theory of the origin of Erb's and other forms of muscular atrophy, as against the nervous theory. F. Rose (*Semaine méd.*, Aug. 20, 1913).

Of 7 living members of a family showing a somewhat atypical form of progressive muscular dystrophy, resembling Erb's infantile type, benign and slow in progress, 4 showed distinct X-ray changes in the pineal gland. A fifth showed an enlarged sella turcica. Pineal disturbances probably play an important rôle in the pathogenesis of progressive muscular dystrophy. Timme (*Arch. of Internal Med.*, Jan., 1917).

PROGNOSIS.—The disease, as a rule, is steadily progressive, but in rare instances may remain stationary. When the malady appears early, duration of life is apt to be short, the child rarely reaching adult years. When the disorder is late in developing, the possibility of an arrest of its development is greater. In any event, however, the prognosis is grave, the patient dying usually from some intercurrent affection, or from implication of the respiratory muscles and diaphragm.

Cases of muscular dystrophy in which there is no hypertrophy survive to old age. H. Batty Shaw (*Lancet*, Jan. 8, 1912).

TREATMENT.—Care should be taken to avoid overexertion or strain upon the already weakened muscular

apparatus. Drugs are practically valueless, except that tonics improving the general physical condition may cause a temporary retardation of the malady.

Carefully regulated **volitional exercises, massage, and passive movements** are of some value. **Electricity**, if used at all, should be applied with great care, as it is capable of doing quite as much harm by overstimulation as it is liable to do good. **Organotherapy** has not proved of value.

Orthopedic operations, such as **tenotomy** for a shortened tendo Achillis, and **tendon transplantation** are advocated by Oppenheim, Hoffer, Kuh, and others, but can obviously be only of transient value.

Fixation of the shoulder-blade to the trunk or of the two blades to each other has been done with some success (Eitelsberg, Raymond). The writer, in a case of subscapular myopathy, found a **mechanical device** of service and of comfort to the patient by keeping the scapula in place.

Treatment of atrophy of a muscle by aiming to restore the osmotic conditions in the muscular fiber, such as are necessary for the dynamic action of the muscle in its normal task. The muscle should be urged to voluntary contractions, then to contractions against resistance, then to contractions against constant resistance during each effort, then with stronger contractions with increasing resistance. Rochard and DeChampassin (*Revue de chir.*, Jan., 1909).

Scapulopexy was successfully performed in a case of juvenile muscular dystrophy (Erb's type) in which the shoulder muscles of both sides were involved in the atrophy, both shoulders presenting distinct flail-joints. Surgical interference was resorted to on the basis of the reflection that under manual fixation of the scapula—which projected under

the fashion of a wing—the arm could be raised to the horizontal plane, and the hand be placed upon the head. The insertions of the first to ninth ribs were exposed by a longitudinal incision 2 fingers' width from the spinous processes and parallel with these; the inner margin of the scapula was freshened, and so were the corresponding points of the ribs. A number of holes were bored through the scapula, and wires were pulled through, twisted around the rib, and fastened in place. The outcome, after bony union had occurred, was excellent; as had been anticipated, the scapula occupied its normal anatomical level, and the arm could be raised to the horizontal plane. Panchet (*Bull. et mém. de la Soc. de Chir. de Paris*, I, xxxiv, 1909).

ETIOLOGY.—The onset of the disease is usually during early childhood, less frequently at about the time of puberty. It may not appear before young adult life, and is seen rarely in middle age. The malady is both hereditary and familial, but sporadic cases are by no means infrequent. It attacks the males chiefly, but is transmitted by the females whether they themselves have been affected or not.

Report of 3 cases of pseudomuscular hypertrophy in one family. The father and mother and their ancestors were apparently healthy. The 3 children affected out of a family of 10 were the eldest boy, now 13 years old; a boy 5 years old, and another boy 17 months old. Poorly developed external genital organ existed in all the cases, especially in the eldest boy. The knee-jerks, especially in the second case, were slightly exaggerated. The superficial reflexes in all were normal and so were the sensory functions and sphincters. The pain on deep pressure was complained of in all the cases. The keloid character of the vaccination marks is a point to be noticed. The father states

that the other children, except the sixth and eighth, also showed signs of enlargement of their muscles when they were young, but this disappeared in two years. R. H. Castor (*Indian Med. Gaz.*, April, 1911).

Family history which seems to indicate at least a marked hereditary tendency of this disease, which has adhered to the original type through three generations. The people among whom the cases appeared were of Scotch and Irish stock and settled in Nova Scotia about 1760. No cases appeared between 1760 and 1820. A couple married in 1815; of this marriage 6 sons and 6 daughters were born. Three sons were affected by this disease; all the daughters remained normal. The remaining sons married and 2 of them reared families, but none of their children were affected, and thus far none of their grandchildren. Each of the 6 daughters married and of their children a total of 7 sons fell victims. All daughters escaped, but the disease reappeared in a son of one of these daughters. The disease pursued a very definite and constant course in all cases. It began before the age of 6 years and each boy died before he was 20 years old. In this family the story of "the crippled boys" is almost a household one and the mothers recognized in many cases before the attending physician that another son had been added to the list. Some of the mothers averred that they knew before confinement that a male child would be born and that he would be a "cripple." They based this belief on the observation that they did not experience the usual amount of quickening, and that the child felt heavy and lifeless in the womb. Whether this was fancied or real, the children were always slower and more lethargic in their movements than normal. Burris (*Can. Med. Assoc. Jour.*, Jan., 1912).

While the actual cause of progressive muscular dystrophy has not yet been discovered, the evidence so far gathered seems to indicate that con-

genital influences are most potent in its development. It has never been explained, however, how it is transmitted from parents to children, or why it appears in the child without the same disease being present in the parents. The writers have studied a number of patients afflicted with this peculiar malady, and, having found that the blood-serums frequently reacted positively to the Wassermann and Noguchi tests, it appeared to them that syphilis might hold an important relationship, and they have recorded the notes of 13 cases in which the original Wassermann technique was employed with all of its controls. To further control the result, each serum was tested out again, using 4 different antigens with all of the controls. In no case was a reaction considered positive unless the test with each different antigen gave a clear-cut positive result, and the same care was used in the results with the families of these patients. Of 27 cases investigated, 7 gave positive serum reactions. In 3 instances one of the parents also had positive reactions, and 1 of these had facial paralysis, which might have been due to syphilis. Unaffected brothers or sisters of patients gave positive reactions in 3 families. Miscarriages were said to have occurred in 5 families. The conclusions drawn from the above facts are that 6 of the patients with myopathy were infected with syphilis, and that it was hereditary, and was, therefore, present before any evidence of myopathy had developed. Cadwalader and Corson-White (*Med. Rec.*, June 7, 1913).

COMPLICATIONS.—As already mentioned, imbecility is sometimes associated with myopathy, which is not surprising when one considers that both are the result of congenital anomalies of development. Oppenheim has seen a case of myopathy in combination with Little's disease.

FAMILY PERIODIC PARALYSIS.

DEFINITION.—A disease characterized by periodically recurring, more or less general, flaccid muscular paralysis, usually hereditary, the attacks alternating with intermissions in which a normal condition exists.

HISTORY.—Family periodic paralysis, which is comparatively rare, was described by Cavaré in 1853, and in somewhat greater detail by Romberg in 1857. Edward W. Taylor, in 1898 (*Jour. of Nerv. and Mental Dis.*, xxv, 637, 1898), found 53 cases of the disease in the general literature, and in 1902 64 cases were collected by Oddo and Audibert (*Arch. gén. de méd.*, 1902).

SYMPTOMS.—The essential clinical feature of the disease is a series of attacks of muscular paralysis, developing usually at night, the patient waking up to find loss of power affecting part or all of the extremities, neck, and trunk. If an attack develops when the patient is awake it is of gradual onset, reaching its height within a few hours. The attack is sometimes preceded by such prodromal symptoms as malaise, headache, backache, bulimia (Holtzapple), increased frequency of urination, and paresthesias. The lower extremities are most constantly affected and may be alone involved, but the malady frequently attacks all the voluntary muscle system except that part supplied by the cranial nerves. In an isolated instance the face was affected. Duration of the attack is from a few hours to a day, two days, or rarely a week, the paralysis passing off gradually. Recurrence takes place at irregular intervals, varying from a few days to weeks or even years. During the attack conscious-

ness is preserved, the sphincters are unaffected, and sensation is normal.

During the paralytic phenomena the electrical reactions are found to be diminished or abolished; reactions of degeneration are not present. The tendon reflexes are also diminished or lost, returning to normal in the interval between the attacks. Evidence of cardiac dilatation and irregularities in cardiac rate and rhythm have been observed.

An interesting observation is that of Holtzapple, who found migraine alternating with the paralytic attacks. Indeed, the history of an individual attack has many features in common with migraine, such as the paresthetic aura or prodromata, perverted appetite, and the gradual onset, duration, subsidence, and recurrence.

PATHOLOGY.—The muscles have been studied both after necropsy and from pieces excised during life. The necropsies were obtained in 2 cases from Holtzapple's series and revealed nothing from which the symptoms could have resulted. Crafts, Singer, Goldflam, and Oppenheim have examined excised portions of muscle, and report such changes as waxy degeneration, vacuolation, and fibrillary hypertrophy. No changes have been found in the nervous system.

Chemical studies are of interest. The toxicity of the urine has been found to be somewhat increased during an attack of the paralysis (Goldflam, Goodbody), and a general reduction in the excretion of urea has been noted (Holtzapple), although increased in one instance during the attack. In another isolated instance acetone was frequently found in the urine during the attack. Of more importance, however, is the observa-

tion by Mitchell, Flexner, and Edsall of a diminished excretion of urea for some time before the attack and a marked increase subsequent to it. The very inconstancy of the toxins found shows the present obscurity of the etiology.

An analogy between the attacks of family periodic paralysis and those of myasthenia gravis has been referred to and a study of the thymus in its relation to the former condition suggested (McCarthy).

That the palsy has its origin in the muscles themselves, and not in the peripheral or central nervous system, is shown by a loss of the muscle irritability to mechanical and electrical stimuli during the paralytic attacks.

ETIOLOGY.—The marked hereditary character of this disease at once attracts our attention in considering the etiology. While isolated cases have been reported, the disease has generally been found occurring in families, extending through several generations and transmitted through either sex. Holtzapple found 17 cases appearing in 4 generations, and Taylor 11 cases in 5 generations.

A study of the heredity aside from the transmission of the peculiar paralysis has revealed nothing of importance except in association with migraine to an extraordinary degree in one family (Holtzapple).

The paralysis commonly appears about the age of puberty, but may occur as early as the second or third year, or as late as 30 or 35.

Exposure to cold (Rich) and overexertion have been mentioned as exciting causes; likewise emotion, shock, overeating, and menstruation. Infections have not appeared to play

any rôle in the etiology, either as underlying or exciting factors.

TREATMENT.—Some of the earlier cases of family periodic paralysis seem to have yielded to quinine, but in the majority no measure at our disposal seems to be of service.

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MUSCLES, SURGICAL DISEASES OF.

STRAIN AND RUPTURE.

What is usually termed a "sprain" signifies an undue stretching of the muscular fibers or their tendinous extremities. It may vary in severity from a slight overextension to absolute rupture. The rupture in severe cases may be partial or complete, the latter being more likely to occur in long-bellied muscles. Rupture of the fibers is often attended by an audible snap, and gives rise to instant pain, which may become excruciating in severe injuries,—the *coup de fouet* of French authors; the patient finds it impossible to perform movements involving the use of the injured muscle. If the tear be marked and near the surface a gap in the tissues may sometimes be felt, corresponding to the ecchymosis, or fluctuating extravasation of blood, of which the injured region is the seat. When the rupture occurs at the knee, marked effusion of the joint soon follows, as in rupture of the quadriceps tendon at its insertion into the patella. When an abdominal muscle is the seat of rupture a ventral hernia may be developed.

In rupture of the biceps neither a pure traumatic rupture nor a traumatic separation of the upper pole occurs. The dislocation of the outer

belly outward occurs in most cases spontaneously. The position of the long head of the biceps and the resulting defects are caused by arthritis deformans of the shoulder-joint. It is an occupation deformity. In the overwhelming number of cases described in the literature as traumatic ruptures of the biceps, there already existed pathological changes in the biceps tendon, and the trauma acted as the exciting cause. Ledderhose (Deut. Zeit. f. Chir., Bd. cl, S. 126, 1909).

ETIOLOGY.—Subcutaneous rupture only occurs when the muscle is submitted to the disintegrating action of great force, or when, through the influence of age or infectious general diseases (particularly rheumatoid arthritis, typhoid fever, etc.), the muscular and fibrous tissues have undergone some process of degeneration. Under such circumstances spontaneous rupture may occur under the influence of slight muscular exertion,—indeed, without any violence, sometimes, through the muscles' own contractile force. Thus, the rectus abdominis may be ruptured during labor merely through its own contractions. Tendons, especially the tendo Achillis, often give way when persons of advanced age jump or dance. I have also seen the biceps humeri and quadriceps femoris ruptured by violence.

TREATMENT.—Moderately severe injuries tend to recover without complications under appropriate measures. The torn ends should, as much as possible, be held in apposition by immobilizing the part in a position wherein the injured muscle or tendon is completely relaxed. New tissue is developed between the separated ends. At first the new tissues are adherent to adjoining structures,

but the adhesions are gradually stretched and absorbed when the patient resumes the use of the muscle. Rupture of the tendo Achillis, for instance, is best treated by immobilizing the leg in the fixed position; a collar around the thigh serves for the attachment of a cord the other end of which is attached to the heel of a soft slipper; rupture of a thigh muscle, on the contrary, requires full extension of the limb in a splint, etc. The parts should be given **absolute rest** by the avoidance of all motion, and **slight compression** should be exercised upon them by means of a bandage. When the rupture occurs in a healthy muscle, it may sometimes be necessary, in order to hasten the recovery or to prevent a long sojourn in bed (a dangerous practice in aged subjects), to expose the parts under strict antiseptic precautions, uniting the separated ends by **sutures**.

HERNIA OF MUSCLE.

Sometimes the fascia, or sheath overlying the muscle, fails to heal, and a portion of the muscle protrudes. During its contraction this becomes especially marked, and an elastic, fluctuating tumor is formed. The muscles of the thigh and abdomen are most prone to this condition, especially if overexertion too soon after the injury is not avoided. Healed fascia under these circumstances may also be torn anew.

Muscular hernia may readily be recognized by the fact that it disappears or becomes prominent according to the proximity of the contraction imposed upon the muscle by motion.

TREATMENT.—Rest and well-adjusted pressure with a hernial bandage are usually sufficient in recent

cases. When much discomfort is caused, or the hernia is an old one, the skin should be **incised** and the **edges of the torn fascia be freshened and united** by chromic catgut **sutures**.

OSSIFICATION.

Localized strains, when repeated, sometimes give rise to local inflammation, culminating in ossification of a part of the muscle. The "rider's bone" is an instance of this complication which is occasionally observed in persons who do rough horseback-riding. The process of ossification takes place in the adductor longus here, but it may occur in any muscle submitted to undue mechanical action. When located in a superficial muscle the "bone" may usually be detected by pressure, but when deep seated it is not recognized during life. Ossification may also be due to syphilis. (See also MYOSITIS OSSIFICANS under MUSCLES, DISEASES OF.)

TREATMENT.—The bony growth does not occasion serious discomfort in the majority of cases, but at times it gives rise not only to local pains, but also to impairment of the functions of the affected muscle. It should then be **removed surgically**, all milder methods being futile.

MUSCULAR DISLOCATION.

Dislocation of muscles and tendons are occasionally observed, when laceration of the fascia, synovial sheaths, and violence concur to cause them to slip over the bony prominence. Dislocation of the peronei muscles over the external malleolus may thus occur during severe wrenches or sprains. The long tendon of the biceps may also be displaced from its groove. The extensor tendons of the wrist are especially prone to this

difficulty. Considerable pain and inability to use the affected limb are at once experienced, and the use of the limb is more or less compromised until reduction is effected.

TREATMENT.—In recent cases reduction of the displaced structure is easily effected by relaxing the muscle and manipulating the member according to the nature and direction of the dislocation. Thus, in dislocation of the peronei, rotating the foot outward is indicated; a retentive **bandage** is then applied and kept until complete recovery is obtained. When the tendon will not remain *in situ*, the **groove** in which it lies may be **deepened** by exposing the bone and **gouging** it subperiosteally, as recommended by Albert.

WOUNDS OF MUSCLES.

Subcutaneous, incised, or lacerated wounds of muscles are frequently met with, especially the latter. Under modern asepsis, unless the loss of tissue be very great or the supply of arteries and nerves be seriously injured (when gangrene is apt to occur), resolution usually occurs promptly in small wounds through regeneration of muscular tissue, and in extensive ones through cicatricial connective-tissue formation. The functions of the injured muscle are often restored under circumstances that would seem to preclude all hope.

TREATMENT.—In lacerated, contused, and incised wounds of any severity, the torn edges, if any are present, should be trimmed off, then united with catgut buried **sutures**. Under aseptic precautions this procures early recovery and the minimum of deformity. In mild injuries close apposition by **strapping** and **rest** are usually sufficient.

MUSCULAR ATROPHY OF TRAUMATIC ORIGIN.

Wasting of a muscle may be of trophic origin through disuse, but also through involvement in injuries of some of the channels through which the nutrition occurs, compression, laceration, etc. Atrophy may thus follow fractures as a result of inactivity, but in the majority of cases reflex disturbance of the trophic nerves is the main cause of the wasting. A fractured limb often affords indications that the nutrition of the limb is impaired, the preliminary factor in atrophy, and simultaneously a warning that its development should be prevented by **local warmth**, **gentle massage**, etc.: *i.e.*, measures calculated to sustain the vitality of the limb while it is immobilized. Pressure upon the blood-vessels may also act as a predisposing factor through malposition of the limb or the constriction of a bandage. The importance of **avoiding prolonged sojourns in bed**, in the case of aged patients, is obvious.

Nerve injuries, diseases of the joints, diseases of the spinal column, etc., also act as causes of muscular atrophy by interfering with the nutrition of muscles either directly or through reflex influence bearing mainly upon the vascular supply.

TREATMENT.—When the limb merely becomes thin through disuse while in a splint, **light massage**, if normal resolution does not soon follow its release, soon causes rapid improvement. *Effleurage*—*i.e.*, strokes directed *toward* the trunk (to activate the circulation) made with the palm of the hand or its radial border—is indicated at first; subsequently, when the limb has become stronger, *pétris-*

sage—i.e., seizing the tissues with both hands and raising them (as a cat is lifted by the neck) repeatedly, followed by kneading of the parts thus raised—should be resorted to. **Strychnine** should also be administered internally.

In atrophy due to lesions of nerves, bones, etc., the cause should first receive attention.

TRAUMATIC MYALGIA.

Muscular pain, rendering the use of the muscle involved more or less difficult, is a frequent result of overuse, especially when the sufferer is not accustomed to arduous labor. Bicycle-riding, horseback-riding, trunk-packing, etc., thus often became a cause of myalgia, the result of fatigue. After two or three days' rest the tissues recover their normal status. Severe myalgia is often caused by strain, twisting, blows, falls, compression, etc. All these factors are most active in causing myalgia in persons subject to rheumatism. (See RHEUMATISM, MUSCULAR.)

TREATMENT.—Heat, light massage, and electricity are valuable remedial means. **Compresses of warm or cold water**, or a **mustard poultice** placed some distance away from the sensitive spot, hasten resolution when spontaneous subsidence is not prompt.

CONTRACTURE.

Permanent fixation of a muscle in the contracted state may be caused by a large number of factors: inflammation of local or remote tissues; traumatic, diathetic, or toxic agencies, etc. Hemiplegia, for instance, is often complicated with contracture of all the muscles of the upper extremity. The arm is usually held

against the body, the hand being flexed upon the forearm and the latter upon the arm: a general contracture of the flexors. In some cases the forearm is merely flexed upon the arm, the latter being free at the shoulder. When this variety occurs in a young woman, hysteria is to be suspected. Contracture of this character may also be due to rheumatism or syphilis, the biceps being the seat of an exacerbation of either disease. Permanent contracture often follows severe traumatism when appropriate curative measures are not immediately instituted. Burns involving the deep cellular tissue and attended by much destruction are also apt to be followed by cicatricial contracture when the region of the elbow or the palmar tissues are involved. Chronic inflammation of a muscle, descending neuritis, persistent irritation along some portion of the motor tract, or prolonged disuse of a muscle if it remain in a given position, weakened action of an antagonistic muscle whether of central or peripheral origin, contiguous bone or joint disease, tumors pressing upon a given set of muscles or its nervous supply are all capable of giving rise to contracture.

In *ischemic muscular contracture* the ischemia may result from a rupture of the inner coat of the artery followed by an infiltration due to venous stasis. In other cases there is a partial or total rupture of the entire thickness of the artery or a simple contusion of the arterial and venous walls, with simultaneous injury of the collateral vessels. The plaster-of-Paris dressing is rarely the sole cause of ischemic contraction. *Bar-denheuer* (Deut. Zeit. f. Chir., Bd. cviii, Hft. 1-2, 1911).

Ischemic contracture is a chronic condition resulting from connective-

tissue changes and consequent contraction. It is not due exclusively, to insufficient oxygen and nourishment, nor to excess of carbon dioxide. An important factor is the inactivity of the muscles. The circulatory disturbances resulting from this begin and the inactivity completes the process of degenerative change. Kroh (Deut. Zeit. f. Chir., cxx, 302, 471, 1913).

The writer emphasizes the importance of psychopathic contractures in persons inclined to hysteria as observed during the war. A tendency to mental weakness and a shrinking from anything liable to induce pain are important factors, supplemented by a weakness in will power. All physicians who have anything to do with war wounds must repeatedly impress on themselves anew that joints grow stiff and useless when not used, and the will power and the brain grow useless unless inertia can be overcome. Dide (Revue de Méd., Nov.-Dec., 1916).

The oscillometer applied in 223 cases of contracture in the wounded and in healthy controls showed that the circulation was always weaker in the contracted hand or foot. The writers found moreover that the circulation even on the sound side was less than normal, although much stronger than on the side of the contracture. When these contractures were suddenly conquered, the pulse on that side at once became as strong as on the sound side. But it was not as strong as in normal controls, and it seems evident that a constitutional or acquired weakness of the pulse is a more or less important element in the development of the contractures. D'Oelsnitz and Boisseau (Bull. Soc. Méd. des Hôp., Nov. 16, 1917).

In palpating hands twisted back on the wrists and other forms of contracture rendering the limb useless after a war wound situated away from the region, the writer was surprised to find that the muscles, instead of being contracted, were completely relaxed. But at the slightest attempt to straighten the limb, the

muscles tightened and became like iron, subsiding anew as soon as the attempts at extension were abandoned. The normal interplay of the muscles had been arrested. This special type of imminent defensive contraction differs entirely from the contracture from a wound of the spinal cord or brain, and seems to be exclusively psychic. Chavigny (Paris méd., Aug. 24, 1918).

The lower extremities are also susceptible to the same influences. Besides the disorders that enter the field of neurology, spasmodic rigidity, and other conditions which sometimes require **tenotomy** or **myotomy**, we occasionally witness contraction of the muscles of the thigh occurring as a result of dislocation or hip disease.

DIAGNOSIS. — Contracture—*i.e.*, permanent shortening of muscles—must be differentiated from temporary rigidity, such as is witnessed in the early stage of inflammation of a joint and in hysteria. The fact that in these disorders the muscles relax under an anesthetic, whereas in permanent contractures they do not, affords an easy and certain way of determining this question. The history of the case usually facilitates the recognition of the origin of the trouble in individual cases. Non-traumatic cases are usually the result of cerebral or spinal lesions, and, in children, of infantile paralysis, owing to the reduced resistance of affected muscles.

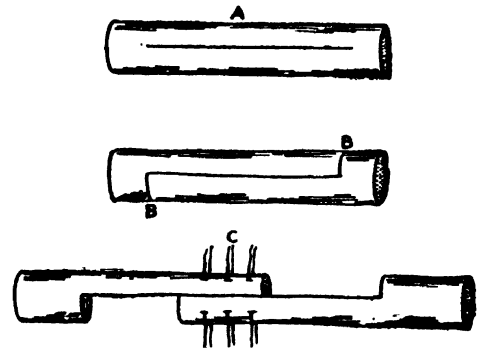
Spinal inflammatory disorders are usually attended by a marked flexion at the hip and knee. As already stated, contracture of the biceps is usually of syphilitic or rheumatic origin; the same may be said of the corresponding leg muscles,

TREATMENT.—The factors leading to contracture are so numerous and the forms which it assumes are so varied that each case must be treated on its own merits. In some, remedies calculated to antagonize a diathetic disorder are of primary importance. In rheumatic and in syphilitic contraction of the biceps, for instance, a course of **potassium iodide** is of primary importance to antagonize the fundamental cause of the disorder and prevent recurrence after **tenotomy**, the second phase of the curative measures indicated. The biceps being the contracted muscle, its tendon is easily cut by passing a tenotome flatwise beneath it from within outward (thus avoiding the artery) and cutting upward by a gentle sawing motion. The wound being closed, the arm is fastened into a **straight splint**, in **extension**, and left there until resolution of the cut parts has sufficiently occurred to warrant **passive motion**.

Lengthening of tendons to overcome contracture has been performed by Anderson, Keen, and other surgeons in the manner indicated in the annexed cut. The tendon being exposed, it is split longitudinally with a thin knife (*A*); each end of the cut is then continued at right angles in opposite directions (*BB*). The tendon being thus severed, its ends are superposed as shown (*C*) and united by means of three catgut sutures. The wound is then closed. Properly performed, this operation procures excellent results. The longer are the united surfaces, the greater are the chances of a successful issue.

When, as a result of operative procedures, the normal action of the muscle cannot be obtained, notwith-

standing additional measures such as **massage**, **electricity**, **friction**, etc., and the internal administration of **strychnine**, it can be supplemented by the use of **rubber bands** (Sayre's rubber muscles) or **springs**, connected with suitably shaped collars, which are fastened around the limb, one about where the paralyzed muscle arises and the other where it is inserted. They are usually of most service in paralysis of the leg muscles. Simple paresis of the latter through disuse may be overcome by measures cal-



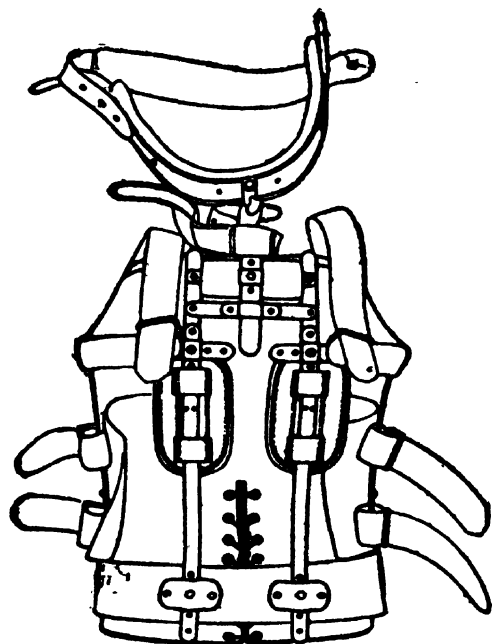
Anderson's operation for lengthening a tendon.

culated to enhance their nutrition,—**massage**, **electricity**, etc.,—coupled with **motion**.

In the prophylaxis of ischemic muscular contracture, constricting bands applied to the upper extremity after trauma should never be allowed to remain longer than two hours; after supporting apparatus has been applied, the condition of the limb should be carefully noted one hour later and once again in the succeeding twenty-four hours. If any one sign or all of the signs of excessive compression appear, viz., loss of tactile sense, loss of power of voluntary motion in the fingers, cyanosis or pallor, swelling, and pain, the **dressing** should be **removed**, the limb **placed vertically** and treated with **hot water or air**, and **active and passive movements** of the fingers practised, together with **massage**. A. Binet (N.

Y, Med. Jour., from Presse méd., Aug. 28, 1912).

The writers cured all but 9 in 143 cases of contracted hand, and all but 6 in 62 cases of war clubfoot, most of them in a single sitting, by **suggestion**. The curability was independent of the duration, of the degree of secondary disturbances, and of the clinical form of contracture. The mental condition is that of hysteria, and this is responsible for the motor disturbance. The



Torticollis apparatus. (G. G. Davis.)

preparation of the patient by a wholesome environment with his mates in the ward, the contagion of example, and the direct or indirect progressive psychotherapy proper of the motor disturbance, are re-enforced by weak faradic electricity. In 81 hand cases and 44 foot cases the contracture was overcome at the first trial. Boisseau and D'Oelsnitz (Presse méd., Mar. 14, 1918).

TORTICOLLIS (WRYNECK).

Torticollis is the name applied to an abnormal position of the head produced by contraction of the muscles on one side of the neck. The

head is drawn downward on the affected side and rotated to the opposite side. If, therefore, the left side of the neck is affected the face is turned toward the right on a vertical axis and likewise somewhat rotated on a horizontal axis.

Torticollis usually occurs in childhood and is sometimes congenital. In the congenital form it has been ascribed to intrauterine disease or injury, such as pressure, but it is undoubtedly, sometimes, the result of injury to the muscle of the neck, particularly the sternomastoid, at the time of birth.

The writer observed 4 cases of congenital torticollis in one family, including the maternal grandmother, mother, and two of her four children. The left side of the neck was affected in each instance, and the deformities were all noticed shortly after birth. D. M. Greig (Brit. Jour. of Children's Dis., Aug., 1913).

In acquired torticollis cold or rheumatism acts at times as a cause; also affections of the throat, inflammation of the glands, and contractions from burns. Paralysis of the muscles of one side and even bad eyesight, as extreme myopia causing monocular vision, may result in holding the head in a more or less permanently incorrect position.

A form exists in adults called *spasmodic torticollis*, from the fact that the neck is the seat of oft-recurring spasms, which twist the head to one side in a very distressing manner. The cause of this form probably lies, in a considerable proportion of cases, in some disease of the central nervous system. The sternomastoid muscle is not apt to be the only muscle involved, the trapezius, splenius, and others being also affected at times.

DIAGNOSIS.—Care should be taken not to overestimate the gravity of the affection. Thus, particularly in children, inflammation of the glands of the neck, tonsils, rheumatism, cervical caries, and mental or ocular affections may cause the head to be held in the position of that of true torticollis, but these cases, as a rule, do not demand operation; so that radical procedures are only to be decided on after careful exclusion of temporary causes.

TREATMENT.—When the affection is suspected to be temporary, treatment should be directed first to the relief of any discoverable cause. Locally, **hot, moist applications:** cloths wrung out of hot water or even persistent **poulticing** may be tried. These are to be followed by gentle **massage** frequently repeated. Internally, **antirheumatic remedies** should be given if that disease is suspected. If any local **support** is desired a simple one may be made of **pasteboard** molded to the part, padded and bound on with adhesive straps or a bandage. If the disease is of chronic, persistent kind, **tenotomy** of the sternal, and if that is not sufficient also the clavicular, origin of the sternomastoid muscle should be resorted to. For this purpose an anesthetic should be given and the tendons and any neighboring contracted bands of fascia should be divided through an open incision. Of course, the strictest antiseptic precautions should be used. It is not worth while to attempt a subcutaneous operation, as the division of all the retaining bands will not be so complete, and even in the hands of an experienced surgeon wounding of the large vessels is liable to occur.

The wound having been sutured and dressed, the head is to be placed in as much an **overcorrected position** as possible, and kept there at least until the wound is soundly healed. One way of accomplishing this is to fix the head in the desired position by means of a **plaster-of-Paris dressing**, which is wound many times around the head, neck, and upper part of the chest. While the plaster is still soft the head is twisted to the desired position and held there until the plaster sets. Another means is to use an **apparatus** consisting of a vertical bar going down the back of the neck and fastened to a light chest-jacket. The upper end of the bar carries a cross-piece, which winds around the occiput and ends above the ears. From the ends above the ears one strap goes across the forehead and another from side to side under the chin. By means of wrenches the back-bar can be bent either around on its axis or else backward or forward, and thus be adapted to the special case. A third way is to surround the head with a properly fitting band, either of metal or leather. From this goes down an elastic band, to be fastened to another band of adhesive plaster on the side of the chest. Any one of these three ways can be used, although sometimes one will seem to suit the particular case better than the others.

Authorities advise that after **tenotomy** for torticollis in children the head should be immobilized. The writer has convinced himself, from the results obtained in 4 cases, that this immobilization is unnecessary. **Passive** and **active motion** should be used. On the second or third day passive motion is begun and on the fifth or sixth day systematic active movements of the head are carried

out. These movements consist in twisting the head and bending. Roth (Lancet, Sept. 9, 1911).

The writer recommends, after the third year of life, **tenotomy** performed in the following manner: 1. A sand-bag is placed beneath the neck of the non-affected side, which puts the contracted tissues on the stretch. 2. A vertical incision, three-quarters of an inch in length, is made between the two heads of the sternocleidomastoid muscle, to within one-half inch of the clavicle. 3. The incision is made through the skin and platysma muscle, exposing the sheath of the sternomastoid muscle. 4. The more contracted tendinous head of the muscle is then made to present in the wound, and a grooved director is passed beneath, upon which the tendon is completely divided. 5. The other tendinous head will now stand out as a tense band, which is likewise made to present in the wound and is divided. 6. Introduce the finger into the wound and search for various muscular or aponeurotic bands, which should be cut. 7. Be careful not to injure the anterior jugular vein behind the sternal head, nor the external jugular and subclavian veins behind the clavicular head. 8. Close the skin incision with interrupted sutures of fine chromic catgut, without drainage. 9. Apply sterile dressing. 10. The head and chin are maintained in the over-corrected position by a plaster-of-Paris cast extending to the pelvis. 11. The cast, unless soiled or broken, is not removed for ten or twelve weeks. C. M. Jacobs (Med. Council, July, 1912).

Case of torticollis due to the effort to avoid diplopia, with relief by **tenotomy** of the overfunctioning muscle—the inferior oblique in this instance—of the secondarily deviating eye. Duane (Arch. of Ophthal., xlv, 33, 1916).

In *spasmodic torticollis* antispasmodic remedies—such as **tincture of cannabis indica**—may be given, be-

ginning with 5 drops, three times daily and gradually increasing—the case being carefully watched—until a dram is being taken. Other remedies—such as large doses of **strychnine**, **hyoscyamus**, and the **coal-tar products**—may also be tried. If these fail, the **spinal accessory nerve** may be **resected** just as it enters the sternomastoid muscle. Attempts have been made to divide the posterior branches of the cervical nerves also. The operation, while in some cases followed by improvement, is very apt to fail in giving much relief, and the disease returns, though perhaps at times in not quite so violent a form as previously.

The sooner the condition in infantile torticollis is diagnosticated and treated, the better the prospects. **Faradic stimulation**, if begun sufficiently early, does much to lessen these inequalities of development; the interrupted current should, therefore, always be given a careful and persistent trial in this disorder. Johnson (British Medical Journal, Sept. 23, 1911).

If the torticollis be of rheumatic origin and acute, and some pyrexia be present, a **purgative** should be given, succeeded by appropriate doses of **salicylate of soda** or by 5 grains (0.3 Gm.) of **acetylsalicylic acid** every six hours. An ointment containing **menthol-methyl salicylic acid** may be rubbed in and the part kept covered. When the acute tenderness is lessening, **gentle manual massage** for a few minutes twice a day is useful, or the mechanical form of massage, by **vibratory movement**, is very soothing. In the more chronic forms the internal administration of **iodide of potassium** and the local application of **linimentum belladonnæ cum chloroformo**, with frequently repeated **massage**, are called for. If the affection is obstinate, **radiant heat** may be employed and the best form is

that derived from an electric lamp of 1 to 500 volts. Care, however, must be taken in its use, as the skin is easily scorched. Tubby (Pract., Jan., 1912).

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Philadelphia.

MUSK.—Musk (*moschus*) is the dried secretion from the preputial follicles of *Moschus moschiferus*.

Musk is very frequently adulterated. A good quality of musk, picked and trimmed, is valued at \$480 per kilogram (Roure-Bertrand). It occurs as irregular, brownish grains contained in an oval sac about 2 inches in diameter, smooth on one side, and covered on the other (outer) side with bristle-like hairs arranged concentrically around a central orifice. Each sac contains from 10 to 40 Gm. of musk.

The odor of musk is most penetrating, causing nausea in some individuals, and even headache and spasm in especially sensitive subjects.

PREPARATIONS AND DOSE.—*Moschus*, U. S. P. (musk), of which from 50 to 75 per cent. is soluble in water, forming a deep-brown, faintly acid, and strongly odorous solution. Dose, 2 to 5 grains (0.12 to 0.3 Gm.) by mouth, in pill or emulsion, or 20 grains (1.3 Gm.) when given in starch water by the rectum.

Tinctura moschi, U. S. P. (tincture of musk), is made by triturating 5 parts of musk with 45 parts of water; allowing to stand twenty-four hours; adding 45 parts of alcohol; macerating the mixture for six days, with occasional shaking; filtering and making up with diluted alcohol to 100 parts. Dose, $\frac{1}{2}$ to 1 fluidram (2 to 4 c.c.).

PHYSIOLOGICAL ACTION.—Musk seems to possess a peculiar action in the relief of collapse and general vital depression. It is also considered to act, under certain circumstances, as a nervous sedative. How these effects are produced is hardly explained by the data at hand, no careful and modern investigation of the physiological action of pure musk having been made.

THERAPEUTICS.—Musk has been thought useful as a stimulant and antispasmodic, especially where *trismus* or other spasmodic conditions complicate

acute febrile disorders. When the strength of the patient is failing and there are manifest such symptoms as *singultus tendinum*, muttering delirium, etc., rectal injections of musk, 10 grains (0.65 Gm.) to a pint (500 c.c.) of starch-water have been recommended. Crookshank specifies that musk is of benefit in acute infection where the symptoms are due to the intense action of toxins on the central nervous system, death appearing likely from their action on the medulla. In *pneumonia* musk was often employed by Trousseau to sustain the patient through the critical period.

In spasmodic disorders, such as *hiccough* and *laryngismus stridulus*; in the persistent *spasmodic cough* that follows *pertussis*, and in *flatulence* musk employed in the form of the tincture appears to have shown at times remedial power. According to Elsner, musk in 1-grain (0.06 Gm.) doses every two hours, continued for several days, may prove useful in *hiccough* complicating *pneumonia*.
W. and S.

MUSTARD.—Mustard, as employed in medicine, is the flour of the seeds of either white mustard (*Sinapis alba*) or black mustard (*Brassica nigra*), both of which are official. Their activity depends upon a volatile oil, *allyl isosulphocyanide* (isothiocyanate) [C_3H_5CNS], which, while not existing as such in the seed, is developed from the glucosid *sini-grin* (potassium myronate) through the agency of the ferment *myrosin* when mustard is moistened with water.

PREPARATIONS AND DOSE.—*Sinapis alba*, U. S. P. (white mustard), consists of yellowish, inodorous, mildly pungent and acrid seeds. Dose, 2 drams (8 Gm.).

Sinapis nigra, U. S. P. (black mustard), consists of deep-red-brown, sometimes gray-tinted seeds, with powerfully irritating odor on moistening, and a strongly pungent and acrid taste. Dose, 2 drams (8 Gm.).

Emplastrum sinapis, U. S. P. (mustard plaster), a uniform mixture of powdered black mustard (deprived of its fixed oil) and a solution of rubber, spread on paper, cotton cloth, or other fabric. When moist-

ened thoroughly with tepid water and applied to the skin, it produces decided warmth and reddening of the skin within five minutes.

Oleum sinapis volatile, U. S. P. (volatile oil of mustard), is obtained from black mustard by maceration and distillation, and yields not less than 92 per cent. of allyl isosulphocyanate. It is colorless or pale yellow, limpid, has an extremely pungent and acrid odor and taste, and is miscible with alcohol. Dose, $\frac{1}{8}$ minim (0.008 c.c.).

PHYSIOLOGICAL ACTION.—Oil of mustard diffuses readily in the tissues, and is therefore capable of causing a deep-seated irritation without actually destroying the more superficial skin strata. The liberation of the oil from mustard is rather slow, and it should therefore be removed from the skin somewhat before the required degree of local irritation has been secured.

UNTOWARD EFFECTS AND POISONING.—Mustard burns or irritations are slow in healing. A mixture of **lime water and olive oil** in equal parts will hasten resolution.

Kolb reports the case of a woman who had taken 6 teaspoonfuls of mustard internally for stomach pains. The next day she was unconscious, cyanotic, with small, irregular pulse (116) and contracted pupils. Respiration was almost arrested—only 3 or 4 to the minute—and of the Cheyne-Stokes type. The urine drawn by catheter was scanty and contained 5 per cent. of sugar and a trace of albumin. On the following day the patient was well, except for an intense general itching of the skin.

THERAPEUTICS.—As an emetic, mustard—1 dessertspoonful stirred into a glass of water—is used when, as in cases of poisoning, rapid emesis is required.

As a **rubefacient** and **counterirritant**, mustard is useful, mixed with flour or some other inert substance to limit its irritating action in **myalgia, neuralgia, sciatica, inflamed joints, colic**, pain in the chest in **pulmonary tuberculosis**, etc. A mixture of 1 part of mustard (English) to 4 of flour for adults, and of 1 to 6 for children and women with delicate skins,

generally proves sufficiently irritating. The mixture should be made into a rather thin paste with cool (not hot) water, vinegar, or white of egg, and spread evenly between two layers of muslin. The official mustard paper is a convenient substitute, but it is too strong for children. It is usually left in contact for one-quarter to one hour. To render the action milder, linen may be interposed between the skin and plaster.

Mustard may be used for the relief of pain in **headaches** of all kinds, and in **gastric disorders** mustard applied in a paste over the organ, just below the end of the sternum.

Mustard foot-baths are useful in the incipient stage of a great variety of disorders, while mustard sitz-baths are helpful in **delayed menstruation**. The latter baths, however, should not be made strong, the delicate mucous membrane of the vulva being easily irritated. In **pulmonary edema** complicating pneumonia a hot mustard foot-bath is recommended. Troublesome **cough** in epidemic **influenza**, **croupous pneumonia**, **exudative pleurisy**, **pulmonary tuberculosis**, and **acute bronchitis** is greatly benefited by the external use of mustard. In adults the mustard may be mixed with an equal amount of wheat flour or other meal; in children the dilution should be greater. Plasters may be placed on the chest and back alternately. Relief from cough in **pulmonary tuberculosis** is, in some cases, procured by the application of a mustard plaster over the trachea or bronchi (King). In pneumonia, influenza, and acute bronchitis a mustard plaster was found by Gorodtsoff a good substitute for morphine or other narcotics.

Heubner considers the mustard pack to exert a very useful revulsive effect in **bronchopneumonia** in children, dyspnea being relieved, cough lessened, and the work of the heart facilitated. He wrings out a large cloth from a mixture made by stirring 2 handfuls of mustard in a quart of hot water, and envelops the child to the neck in it for twenty minutes. A simple warm-water pack is then substituted for two or three hours. Sweating having occurred, a lukewarm bath, followed by a cool shower, is given, and the

child left quiet in bed for twelve hours. The interval between successive mustard packs should not be less than twenty-four hours.

W. and S.

MYALGIA. See **RHEUMATISM, MUSCULAR.**

MYASTHENIA GRAVIS. See **MUSCLES, DISEASES OF.**

MYASTHENIA PSEUDOPARALYTICA. See **MUSCLES, DISEASES OF.**

MYCOSIS FUNGOIDES.—DEFINITION.—Mycosis fungoides (granuloma fungoides; inflammatory neoplasms; lymphodermia perniciosa; multiple sarcoma cutis; sarcomatosis generalis; Alibert's disease) is a chronic, progressive, malignant skin affection, characterized primarily by an eruption of an urticarial, eczematoid, or lichenoid appearance and later by ulcerating fungoid tumors, and having a fatal termination.

SYMPTOMS.—The primary manifestations, or premycotic stage, may occur on any part of the body in the form of patches resembling those of erythema, eczema, psoriasis, lichen, urticaria, or pityriasis rubra. These lesions continue without much change for a period ranging from a few months to several years. In the second (mycotic) stage the lesions are seen to be raised above the surface and have a glistening aspect and a deep-red color. Papules as large as a pea develop, some of which disappear for a time, and then reappear. They may disappear from one region entirely and fresh ones appear elsewhere on the body. This stage may persist for months or years. The lesions give rise to much pain and itching. After a varying time well-marked tumors form, at first on the trunk, later on the extremities, either from a coalescence of adjacent papules or by new formation, hemispherical, oval, or irregular in outline, sometimes pedunculated, bright or dark red in color, and either hard or soft in consistency. In this stage large patches of infiltration may be present. The epidermis becomes thinned and glistening. Tumors may be observed in different phases of evolution or retrogression. Some undergo resolution and are absorbed; others ulcerate and

form a fungous mass. During the progression of the disease the tumors may develop all over the body, and may involve mucous membranes, appearing upon the tongue, palate, and larynx. In this stage the pain and itching usually diminish, but painless enlargement of the lymphatic glands appears.

Though the general health may remain unaffected for a long time, a condition of marasmus develops and the patient dies from an attack of diarrhea, from pulmonary complications, or from septic infection. The disease is fortunately a rare one, and it almost always has a fatal termination.

DIAGNOSIS.—Clinically, mycosis fungoides, in the early stage, stimulates the various affections already mentioned. From the common forms of erythema it may be distinguished by the sharply defined limit of its patches. From eczema it may be differentiated by the persistence of its lesions. From psoriasis it differs in the unusual location and unusual chronicity of its lesions. While the evolution, retrogression, and fungous appearance of the tumors would indicate this disease, the new growths themselves might be confounded with sarcoma, but it must be recollected that in sarcoma the lymphatic glands do not suffer enlargement, nor do the neoplasms often disappear by resolution.

Histologically, mycosis fungoides may be confounded with the granulomata of tubercle and syphilis, the sarcomata, and the leukemic and pseudoleukemic growths of the skin. It resembles syphilis in many particulars. It differs from cutaneous tuberculosis in that giant cells with central caseous degeneration do not occur. In the skin lesions of leukemia the vessels of the cutis are affected with marked edema and there is active diapedesis from them, with subsequent infiltration of the adjacent cutis with leucocytes; simply a leucocytic infiltration without marked fixed-cell proliferation, mitosis, or imperfect giant-cell formation, as is seen in mycosis fungoides. Pseudoleukemia cutis resembles syphilitic granuloma more than mycosis fungoides.

ETIOLOGY AND PATHOLOGY.—Mycosis fungoides is believed to be an

infectious granuloma, probably due to a microparasite (Schamberg). Galloway and Macleod have found that in the pre-fungoid stage there is a connective-tissue-cell proliferation around the blood-vessels of the subpapillary and papillary layers, the hair follicles, sebaceous glands, coil ducts, and occasionally the coil glands, and forming foci independent of these structures among the connective-tissue bundles. In the epidermis active mitosis of the prickle cells and downgrowth of the interepithelial processes were noted; also nests of corium tissue in the mucous layer and interepithelial edema going on to the formation of reticular spaces. To the tumor stage the cell proliferation increases, and the cells show a marked tendency to break down, shown by the crenation, irregularity, and fragmentation of the cells. The granuloma encroaches on the downgrowing epithelium, flattens it out, spreads up to the surface, and is covered only by a layer of the stratum corneum.

TREATMENT.—The itching of the early stage is to be relieved by applications of antipruritic remedies in proper dilution. Pain may require the use of morphine.

Arsenic, hypodermically, has been found beneficial by Köbner. The general condition should be kept as favorable as possible through administration of **tonics** and **good food**.

Local applications of **ichthyol**, **pyrogallol**, **resorcinol**, **camphorated naphthol**, and injections of **phenol** have been used. The ulcers are best dressed with antiseptics, such as **iodoform**, **acetanilide**, **iodol**, **europen**, **thymol iodide**, **bismuth subiodide**, etc. Cleanliness of the entire skin surface should be maintained. Persistent **purgation** was apparently the cause of recovery in 1 of Crocker's cases.

The most efficient remedy is the **X-ray**; it is most effective when applied early in the disease; in the later stages it apparently merely controls the process during the time of its use. The itching is often greatly relieved by it.

Rapid disappearance of the lesions under the rays has been known to induce a pronounced toxemia, apparently responsible for death in one of C. J. White's cases;

careful attention to dosage is therefore required.

Experiments showing that the *Streptococcus mycosis fungoides* is very vulnerable to **ethylhydrocupreine**, an injection of which within six hours will save an animal infected with 10 times the fatal dose. In case of reinfection after eight or nine days the animals frequently survived, showing that a certain degree of immunity had developed. R. Levy (Berl. klin. Woch., Dec. 30, 1912). W.

MYELITIS. See SPINAL CORD, DISEASES OF.

MYOCARDITIS. See HEART AND PERICARDIUM, DISEASES OF.

MYOMA. See OVARIES AND FALLOPIAN TUBES, and UTERUS.

MYOPIA.—This term is applied to the partial closure of the lids to render vision less indistinct, by narrowing the circles of diffusion on the retina: an action of which myopes generally learn the benefit.

DEFINITION.—That error of refraction in which the principal focus of the dioptric surfaces lies in front of the retina. Rays parallel when they enter the eye come to a focus in the vitreous, and diverge again, forming a circle of diffusion upon the retina. The eye is too long anteroposteriorly, as compared with the curve of its surfaces.

SYMPTOMS.—The elongation of the eyeball may be part of its general enlargement in all directions, and in any case makes the front of the eye prominent, so that it looks large. In high myopia this elongation is very evident when the eye is turned strongly toward the nose. The pupil is often large and the anterior chamber deep. The expression of the patient is likely to be rather vacant. He is unable to perceive much of the facial expression of others,

and hence does not learn to respond to it by facial movements of his own. All distant vision is indistinct; the myopic child, therefore, is at a disadvantage in many games, and is inclined toward reading and other amusements requiring only distinctness of near vision. The constant effort to bring the eyes near to the object looked at is likely to cause an habitual stoop.

Myopia of high degree is mostly attended by divergent strabismus. The elongation of the eyeball makes it very much harder to turn in its socket, and the limiting of the range of distinct vision to a near point compels the myope to converge his eyes to a greater extent and to converge them more constantly than if normal. As the myopia increases, this need and difficulty of convergence increases, until the effort becomes too great to be habitually sustained, binocular vision is given up, and the worse eye allowed to squint. The process of elongation of the eyeball is, in the vast majority of cases, distinctly pathological and attended by changes in the coats of the eye, especially by disturbance and atrophy of the choroid in a crescentic area at the temporal side of the optic disk: the so-called myopic crescent. In high myopia the vitreous humor usually shows opacities and may be abnormally fluid, the crystalline lens is liable to become partly opaque, and the retina often becomes detached. Distant vision is always worse than near vision; but the latter may also be very imperfect. Headache is not usually present. But excessive efforts of convergence may give rise to headache, vertigo, or the inflammatory symptoms of eye-strain.

DIAGNOSIS.—Myopia is recognized and measured by: the improvement of vision by concave lenses, the

weakest lens giving the best distant vision being the measure of the myopia; the blurred image in the direct method of ophthalmoscopical examination, rendered clear by a concave lens which corrects the myopia, and the reversal of movement by skiascopy, the distance of the point of reversal from the eye being the focal distance of the correcting lens.

ETIOLOGY, PATHOLOGY, AND VARIETIES.—Myopia may be due to excessive curvature of the cornea, or crystalline lens,—*myopia of curvature*,—or to an increase of refractive power in the lens substance,—*index myopia*; but the great majority of cases are due to elongation of the eyeball,—*axial myopia*. Myopia is often observed temporarily for a few weeks or months after an attack of iritis or iridocyclitis,—*inflammatory myopia*. This last is probably due to alteration of curvature in the lens, although an alteration of index has been suggested. Prior to senile or diabetic cataract myopia may develop, probably by increased refractive index of the lens nucleus, or diminished index of refraction in the lens cortex. This change enables old people who have previously required convex lenses to read without them, and is therefore called "second sight." It is but a temporary benefit, and not an unmixed good. To the extent that near vision is gained distant vision is lost, and both are lowered by the haziness of the crystalline lens.

The mass of cases of myopia develop in eyes, not myopic at birth, from excessive strain of near-seeing. Heredity, bad hygienic surroundings, and impaired general health are predisposing causes. But the efficient exciting cause is excessive near work for the eyes.

During near vision the eye muscles are actively innervated, and the eyeball compressed laterally between them, so that there is a constant tendency to force it to elongate. The condition of congestion of the choroid and inflammatory softening of the sclera, that develops under excessive use of the eyes for near work, causes the sclera to give before the intraocular pressure, and permanent change in the shape of the eyeball results. As myopia increases, distant vision becomes less perfect, the range of clear vision more restricted, the efforts of convergence of the eyes greater and more constant, and at the same time the sclera is thinned by distention and less able to withstand the pressure of its contents. In this way the myopia tends to go from bad to worse, becomes *progressive*, and when this progress has become so great that it cannot be checked it is said to be *malignant myopia*.

The idea has sometimes been entertained that use of the accommodation tended to increase myopia by increasing the intraocular tension; but this is directly disproved by both clinical and experimental studies of the subject. Many hypotheses have been advanced regarding myopia without any sufficient basis of facts, namely: that heredity acted by determining the proportions of the cranium or the shape of the orbits, or that a special diathetic or vascular condition was the chief determining factor in the case. Recently Levinsohn has suggested that gravity causes elongation of the eyeball when stooping forward. This view he supported by experiments on monkeys, which were suspended with the head downward until myopia seemed to result. The large number of myopic eyes that also exhibit considerable astigmatism make

it probable that strain of the eyes from astigmatism, causing choroidal disturbance and scleral softening, is an important factor in many cases.

TREATMENT.—Myopia should be corrected by **concave lenses**, which should be worn constantly. For young persons the **exact optical correction** should be worn all the time, although in rare cases it may be better to use a weaker lens for a time for near work. Presbyopes will always require, for near seeing, a lens sufficiently weaker to make up for their presbyopia. The correcting lens gives the myope distinct vision and the visual range of the emmetropic eye, and places the check of accommodative effort upon the tendency to excessive convergence. Correcting lenses may be unsuitable for those cases in which binocular vision, and, therefore strain of convergence, have previously been given up; or where the vision is so imperfect, or the minifying effect of the correcting lenses so great, that objects will still be held close to the eye to gain the benefit of larger retinal images.

The incomplete correction of myopia, unless the glasses are so weak as to be of no material benefit, is extremely dangerous. By looking through such lenses obliquely the myope soon finds that he can see farther and more distinctly than by looking squarely through them, and he soon falls into the habit of looking obliquely. By looking obliquely through a lens the pencil of rays received by the eye is rendered astigmatic, and the evils of high uncorrected astigmatism are thus entailed. When the **full correction** for the myopia is worn, looking obliquely through the lenses makes vision worse and is instinctively avoided.

The wearing of correcting lenses en-

ables the myope to reduce his efforts of convergence to nearer the normal. But there still remains the increased difficulty of turning an elongated eye in its socket. To help still farther, the amount of **near work** required of such eyes must be **limited**, and surrounded with the most favorable conditions, including the use of the **best illumination** and a **correct posture**, with **frequent interruptions** during which the **eyes are permitted to rest on distant objects**. These precautions are of the greatest importance during childhood and adolescence, when myopia begins and shows the most general tendency to increase.

Operation.—The surgical treatment of myopia by **removal of the crystalline lens** is appropriate for a few cases of very high degree—15 D. and upward—in which correcting lenses give unsatisfactory results although the eyes are capable of good vision. In children the removal is to be effected by a small discission of the lens, repeated several times, if necessary, until the absorption of the lens substance leaves a clear pupil. In adults the lens may be extracted after a preliminary small discission to render it opaque. The operation is quite as formidable and dangerous as that of the removal of the opaque lens,—cataract. (See Volume II.) The removal of the crystalline will generally correct about 18 D. of myopia, and the higher the myopia, unless it be due to increased curvature of the cornea, the greater will be the effect of the operation. The removal of the crystalline also gives a larger retinal image than can be obtained through concave correcting lenses, with a correspondingly superior acuteness of vision. In cases suitable for this

operation such improvement should amount to 50 or 60 per cent. After removal of the crystalline, although the patient is much less dependent on his glasses, they will still be necessary to secure the best vision, and different lenses will be required for near and far seeing, on account of the loss of all power of accommodation.

EDWARD JACKSON,
Denver, Colo.

MYOSITIS. See MUSCLES, DISEASES OF.

MYRRH (myrrha) is a gum-resin obtained from *Commiphora myrrha*. It is official in all pharmacopeias. Official myrrh is collected by the Somalis in northeastern Africa, partly from natural fissures and partly from incisions made for the purpose. It is first yellowish white, but as it hardens it becomes darker and finally of a reddish-brown color. It occurs in irregular, more or less rounded nodules or tears, from 2.5 to 10 cm. (1 to 4 inches) in diameter. It contains from 2 to 5 per cent. of a volatile oil, which imparts to it its characteristic odor. A resin constitutes from 25 to 50 per cent. of myrrh. The remainder is largely gum.

PREPARATIONS AND DOSE.—

Myrrha, U. S. P. (myrrh), forms a brownish emulsion when triturated with water. Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

Tinctura myrrhæ, U. S. P. (tincture of myrrh), is a 20 per cent. preparation. Dose, 15 minims (1 c.c.).

Myrrh is also contained in the following compound preparations:—

Pilulæ rhei compositæ, U. S. P. Dose, 2 pills.

Pilulæ aloes et myrrhæ, N. F. Dose, 2 pills.

Tinctura aloes et myrrhæ, N. F. Dose, 1 fluidram (4 c.c.).

Mistura ferri composita, N. F. (Griffith's mixture). Dose, 4 fluidrams (16 c.c.).

Tinctura capsici et myrrhæ, N. F. (hot drops). Dose, $\frac{1}{2}$ fluidram (2 c.c.).

Tinctura antiperiodica, N. F. (Warburg's tincture). Dose, 4 fluidrams (16 c.c.).

THERAPEUTICS.—Myrrh has astringent, carminative, antiseptic, and possibly emmenagogue and expectorant properties. Locally, the tincture of myrrh, as such or diluted, is a useful application to **spongy gums**, in **aphthous stomatitis**, and to **indolent ulcers**. It has been used internally, with asserted benefit, in the later stages of **bronchitis**, in **chronic cystitis**,

and in the **leucorrhea** of **chronic metritis**. In **scurvy** the administration of teaspoonful doses of tincture of myrrh mixed in with some astringent infusion or decoction has been recommended. W. and S.

MYXEDEMA OR PROGRESSIVE HYPOTHYROIDIA. See **THYROID GLAND, DISEASES OF.**

N

NAILS, DISEASES AND INJURIES OF THE.—Besides the implication of the nail in general morbid processes—such as syphilis, neuritis, leprosy, etc.—there are several strictly local diseases that require special notice.

ATROPHY.

Atrophy of the nail (*atrophia unguium*; *onychatrophia*), either congenital or acquired, is characterized by a decrease in size or thickness, splitting, crumbling, softening, and discoloration. In the congenital form the nails may be absent, distorted, or defective. Acquired atrophy may be caused by any general or local disturbance affecting the matrix, as traumatism, syphilis, fevers, etc. The nail may become smaller and thinner, flexible and easily broken, or soft, granular, and present a worm-eaten appearance. The surface of the nail may be smooth and normal in appearance, or may be discolored, opaque, or yellow and fissured.

The white spots often observed on the nails (*leuconychia*) are an indication of subnormal vital energy, the result, often, of exhausting disease, dissipation, sexual excesses, overwork, or worry.

TREATMENT.—The first indication is to remove the cause if possible. If the diseased nails are painful or interfere with the patient's work, the use of **soothing ointments**, and the application of **wax, gum, or flexible collodion** on the nails as a protective covering, will afford relief. The subsequent use of **oils and ointments** applied over the nails will improve this condition.

If this prove insufficient, **acid nitrate of mercury** must be used after anesthetizing

the parts with a 10 per cent. solution of cocaine. Such an application may also be rendered painless, according to Randolph, by saturating **nitric acid** with the **cocaine hydrochloride**.

The nail groove may be excised and the matrix scraped, or the nail may be removed and the remaining ulcer dressed with powdered **lead nitrate**, **iodoform**, **iodol**, **thymol**, **iodine**, **aristol**, or **euophen**—**constitutional treatment** is demanded in all cases.

HYPERTROPHY.

This affection (*hypertrophia unguium*; *onychauxis*), usually ascribed to pressure, is characterized by an increase in the length, breadth, or thickness of the nail, and may be either congenital or acquired, idiopathic or symptomatic (as in eczema, psoriasis, syphilis, ichthyosis, etc.). There may be simple enlargements, without change in quality or texture, or there may be structural changes, the nail becoming roughened, furrowed, or opaque, and in some cases of a yellowish-brown or black color.

If the growth is lateral, inflammation of the surrounding tissues (*paronychia*) may ensue, or it may cause inflammation of the matrix (*onychitis*). When the nails become curved and claw-like the condition is called *onychogryphosis*.

Though the growth is very gradual, pressure upon the underlying tissues causes local disorders, especially if the nail cracks, when painful inflammatory symptoms follow. It produces heat and discomfort when affecting the feet, shoes being worn with difficulty. When the nails of the hands are the seat of the

hypertrophy it constitutes quite a deformity.

TREATMENT.—The overgrowth should be filed down or sawed. In other words, measures tending to give the nail its normal shape should be resorted to. All complications are of the nature of those attending the so-called "ingrowing toe-nail," and the treatment given for the latter condition (see below) is also applicable.

NUTRITIVE ALTERATIONS CAUSED BY DISEASE.

ECZEMA.

Eczema produces the most frequent examples of nail disease. The changes may occur on the nail walls, matrix bed, and plate, and are brought about by the etiological factors of the primary disease. Generally appearing after the age of 20, it continues throughout adult life.

In the acute form the nail walls are red and swollen, the plate becomes more convex, rough, lusterless and discolored, and soft spots occur in it, which become minute punctate depressions. Pain is felt in the bed.

In the subacute and chronic forms the nail may be the seat of transverse depressions or ridges, vertical ridges, hyperkeratosis of the bed, with increase in the convexity of the plate and, later, a disappearance of the granular detritus, and thinning of the plate with increased brittleness, exfoliation of the surface cells of the plate, leuconychia, or final loss of the nail. A deep transverse furrow may result, if the matrix is affected.

TRAUMA OR FELON.

When the matrix is unaffected by these accidents, or when they are slight, the nail-changes are insignificant. When the matrix is involved a permanent change occurs that is indefinitely reproduced. These constant deformities are transverse depressions, vertical ridges, hyperkeratosis subungualis and its sequelæ, and discoloration. Less often the changes are round punctate depressions, atrophy, exfoliation of plate surface, increased convexity, brittleness, opacity, koilonychia (spoon-nail), gryphosis, leuconychia, transverse ridges, vertical depressions, invasion of air into the plate, and subsequent crumbling or entire loss of the nail.

PARONYCHIA.

This is an inflammation of the tissues around the matrix and occurs usually in washwomen or scrubwomen and in those who subject their fingers to constant irritation. In these cases the nail becomes discolored and the seat of transverse depressions and hyperkeratosis subungualis; there is a lifting of the plate which allows the keratotic granules to leave the bed, leaving a flat, horny floor covered by a thin, dome-shaped roof. Although these alterations are the usual ones, any of those produced by eczema may occur.

TREATMENT.—A pledget of cotton should be packed in between the nail and the soft parts, the imbedded portion of the nail having been previously excised.

PSORIASIS.

While psoriasis of the nails does not present itself as often as eczema, involvement of the nails in cases of cutaneous psoriasis is more frequent. It occurs most frequently in men between 20 and 40. Unna and Heller observed that round punctate depressions in the plate were pathognomonic of psoriasis, to which opinion C. J. White, of Boston, takes exception, as he has found these lesions in 27 cases of eczema of the nails. According to White, the most frequent (57 per cent.) lesion is hyperkeratosis of the bed, with its subsequent changes. Discoloration, varying from yellow to dark brown, and transverse depressions occur in about 38 per cent. of the cases. Less frequently found are simple hyperkeratosis subungualis, brittleness of the plate, thinning, opacity, vertical ridges, exfoliation, increased convexity, total loss of nail, broken nail, koilonychia, loss of luster, transverse ridges, and vertical depressions (C. J. White). The psoriatic papules form on the bed, raise up the plate, and allow the air to enter the plate cells, producing opacity and discoloration.

DERMATITIS PROFESSIONALIS.

These cases are due to some noxious occupation, or an accidental poisoning of the skin. White noted the presence of koilonychia in 40 per cent. of his cases and mentions as other changes round punctate depressions, discoloration, transverse depressions, vertical ridges, and

hyperkeratosis subungualis, with its sequelæ.

SYPHILIS.

This is not a common affection of the nails. When the nail wall is the seat of primary chancre, a series of parallel transverse depressions, with or without discoloration, develops, or the plate may ulcerate and drop off.

In the secondary stage the disease may be characterized by the formation of a papule on the bed, or by a general, moist elevation of the nail.

The tertiary lesion is usually a dry one; white punctate depressions form in vertical series at the root of the nail and there is hyperkeratosis of the bed or a thickened, yellow, crumbling plate.

TINEA TRICHOPHYTINA.

This condition (onychomycosis; ringworm of the nails) is a very rare one. It is caused by *Tinea megalosporon*, and appears first at the distal portion of the nail, gradually spreading backward. The megalosporon first attacks the bed, producing opacity and a discoloration of the plate, at first whitish yellow, later brown, or even black. With the progressive darkening color the bed becomes increasingly hyperkeratotic; the plate is raised more and more from the bed and exhibits transverse depressions or elevations, or vertical ridges; the plate becomes roughened upon the surface, exfoliates, atrophies or splits, and becomes loosened. Chronicity marks this disease. Under proper treatment two years are necessary for its cure, while, untreated, it may endure actively for thirty years. Ringworm elsewhere on the body may aid in the diagnosis, which is otherwise difficult.

TREATMENT.—Soften the nail with a solution of potassium hydroxide, remove as much of the diseased portion as possible, and keep the remainder covered with a 10 or 20 per cent. ointment of mercury oleate until the entire diseased area exfoliates or is replaced by new and healthy growths. Solutions of mercury bichloride, and of creosote, and the oleates of copper and tin are also useful (Shoemaker).

TINEA FAVOSA.

This affection (*tinea favosa unguium*; onychomycosis favosa), though rare, is

more common than ringworm, and its appearance is similar to the latter. It is caused by *Achorion schönleini*, which attacks the distal end of the bed and causes an opacity and discoloration of the plate. As in ringworm, the hyperkeratosis spreads backward, and the plate, raised from its bed, becomes increasingly darker, even black, and transverse depressions or ridges appear on its surface. When the plate is attacked it assumes a honey-combed appearance, leading on to crumbling, splitting, and final exfoliation of the nail. This affection in its course and treatment resembles that of ringworm.

NUTRITIVE ALTERATIONS IN OTHER DISEASES.

The pallor of the nails in anemia and chlorosis; their lack of luster in syphilis and gout; the subungual hemorrhages in scurvy, and the subungual ecchymoses in diabetes; the development of furrows, fissures, and ridges in chlorosis, Morvan's disease, cyclical insanity, rheumatism, typhus, typhoid, and relapsing fevers, and after seasickness, nervous exhaustion, and scrofulosis; the shedding of nails in diabetes, locomotor ataxia, alopecia, hysteria, fevers, and small-pox; the talon-like nails of Morvan's disease; the hypertrophied nails of acromegaly; the enlarged, horny nails of scrofula, and the thick, curved, clubbed nails of tuberculosis are well-known conditions.

CONTUSION.

Contusion of a nail by a blow, a compression, etc., is a common occurrence. Unless sufficient to cause destruction of the matrix, the result of such an injury is usually slight, the acute pain quickly disappearing; in some cases a subungual hematoma is formed. When, however, the traumatism is serious and the nail is torn off, severe suffering is induced, which may persist a long time. Again, infection may occur, leading to inflammation and suppuration.

TREATMENT.—Slight cases of contusion require no treatment. After a few minutes the pain generally decreases, then ceases, and the ecchymosis that shows through the nail is generally eliminated through the growth of the nail.

In severe cases the finger or toe should be immersed in a hot saturated solution

of **borax**, then dressed with **iodoform** or **orthoform** if pain continues. The dressing should be changed every day where a toe is the seat of injury. If the nail is partly torn off, it should be carefully **cleansed** along with the underlying tissue, **replaced**, and **retained with a bandage** applied over the dressing.

ONYCHIA.

This is an inflammatory disorder of the matrix of the nail, popularly called a *run-around*, which may follow an injury such as that first described or the introduction between the nail and the underlying tissues of infectious matter, along with a foreign body (a thorn, a splinter, etc.). The finger-tip becomes warm and congested, and severe pain is generally present. An abscess is formed after a few days, the pus being evacuated through the aperture formed by the offending body. If none such exists, the nail may become softened and perforated. When the accumulation of pus is marked, there may be febrile and other symptoms denoting general involvement.

In the vast majority of cases, however, the symptoms generally become less marked and involution soon follows, sometimes after the loss of the nail. This is always replaced, though not always by as perfect a nail as the one shed.

TREATMENT.—The treatment indicated is by antiseptic methods that tend to destroy the infectious germs. **Hot-water baths**—as hot as can be borne—sometimes speedily arrest the process. **Alcohol** acts in the same manner. If a splinter or other infectious body have penetrated the tissues, the pus-cavity can usually be penetrated without pain with a hypodermic needle and **washed out with a 1:5000 mercury bichloride solution**. Bathing the finger in such a solution at frequent intervals, or, better still, leaving it therein an hour several times a day, sometimes arrests the infectious process early in its career. Whenever there is imprisoned pus, it should be liberated by an **incision** and the **cavity washed out**, using a hypodermic syringe. Incision into the flesh, according to Tousey, is always radically wrong, even though the pus be nearly a dram (4 c.c.) in amount. The **attachment of the cuticle**

to the dorsal or exposed surface of the nail should be **separated by a tenotome** to a sufficient extent to permit the escape of the pus and the introduction of a stick of **silver nitrate** to disinfect the sulcus. With this treatment there is no disfiguration. **Hydrogen dioxide**, diluted (1 part in 3), is very effective in such cases.

MALIGNANT ONYCHIA.

This is a complication of the disorder just outlined, which may occur in persons who are constitutionally weak or adynamic or in scrofulous or lymphatic children. It usually affects the index finger, the thumb, or the big toe, and is the active manifestation of a local ulcerative process in the matrix of the nail. The latter becomes brownish or black, and is shed, leaving underneath a granular fungous mass which shows no tendency to heal. The finger sometimes becomes enormously enlarged and discharges considerable fetid pus. Necrosis of the bone of the phalanx involved occasionally follows.

TREATMENT.—Proper active measures usually prove promptly effective. The **nail** should be **removed** with forceps. Pain may be prevented by first injecting a 4 per cent. solution of **cocaine** under the nail. The parts are then dressed with **iodoform**. A day or two later, after brushing the parts with a 4 per cent. solution of **cocaine**, the ulcerating area is touched with **silver nitrate**, **burnt alum**, or **tincture of chloride of iron**. This should be repeated, if need be, several times at two- or three- day intervals.

INGROWING TOE-NAIL (LATERAL ONYCHIA).

The term "ingrowing toe-nail" is applied to a condition usually confined to the great toe, in which the edge of the nail (almost always the outer edge) is forced into the adjoining soft parts. Swelling of the latter being induced, they overlap the nail, the point or line of contact becoming the seat of ulceration and granulations. It is usually due to the pressure of tight shoes, and is therefore generally met with in young adults. It is also frequently encountered in soldiers as the result of prolonged marching with heavy accoutrements that increase the pressure upon the feet. Lymphatic sub-

jects are more liable to it than others, and the affection is exceedingly persistent in them. It often accompanies diabetes and may occur as a complication of febrile diseases of long duration, fractures and other processes tending to debilitate the organism, hyperidrosis, etc., but most frequently as a result of badly shaped shoes.

TREATMENT.—In mild cases **broad-toed shoes** giving freedom to the toes, **frequent ablutions**, and **finely powdered sodium borate** (borax) or **tannic acid** applied to the dressed tissues usually suffice for a cure. The mere daily introduction of **cotton under the lateral edge of the nail**, by gradually raising the latter away from the soft parts, sometimes yields very satisfactory results. **Scraping the center of the nail** until it is quite thin occasionally suffices to relieve the pressure.

In the great majority of cases the ulceration requires active measures besides a change of footwear. The ulcerated tissues must first be relieved of their granulations. This can easily be done by using **tincture of ferric chloride**, **burnt alum**, **hydrogen dioxide**, **powdered lead nitrate**, etc., after anesthetizing the parts with a 4 per cent. solution of **cocaine**. Or, they may be scraped with a **curette** or gently **cauterized with the mitigated stick**, **zinc oxide**, and **silver nitrate**. This being done, a small piece of cotton-wool covered with **iodoform**, **iodol**, or **aristol** is gently inserted with a probe into the diseased cavity, the **soft parts** being raised away from the nail. These measures do not always procure a radical cure, however, particularly if the patients again use narrow or short-tipped shoes. In such cases **surgical measures** are preferable. The simplest of these is to anesthetize the tissues—or the patient—and, after careful cleansing of the parts, to simply **pare off the redundant tissues**, granulations and all, on a level with the edge of the nail. The nail-edge being then carefully trimmed, an **iodoform dressing** is applied. Or, the diseased parts may be **dissected out** and a plastic union obtained by a few stitches.

Another method is to apply a warm 40 per cent. solution of **liquor potassæ** to the portion of the nail to be removed. After

a few seconds the uppermost layer of the nail will be so soft that it can be **scraped off** with a piece of sharp-edged glass; the next layer is then moistened with the same solution and scraped off; this must be repeated until the remaining portion is as a thin sheet of paper, when it is seized with forceps, lifted from the underlying soft parts, and **excised**. This operation, according to Pürckhauer, is both painless and bloodless.

J. L. Andrews states that **plaster applied diagonally around the toe** in such a manner that the **soft parts** shall be **drawn away from the nail** without direct pressure over the latter is sometimes efficient in ingrowing toe-nail.

The older surgeons recommended an evulsion of the nail, an operation performed by forcibly inserting a scissors under the nail in the mesial line; but this is now condemned because the new nail is generally a malformed one and hypertrophy occasionally follows.

A number of other operations have been suggested. **Cotting removes the soft parts**, healthy and diseased, down to the margin of the nail. This is curative in many cases. **Anger excises the diseased tissue and removes half of the nail**. **Dowd** does a similar operation, but, in addition, **destroys the matrix** and closes the wound with stitches. Many good results follow these latter operations. **Keller splits the nail in the center** through the matrix down to the bone and **frees the matrix and lateral border of the nail** by an incision down to the nail, about $\frac{3}{16}$ inch from the lateral borders and extending back beyond its base. These **lateral borders are freed, elevated, and carried out over the healthy tissue**, and the **matrix of the elevated portions is removed**.

Van Meter excises a diamond-shaped piece of tissue, at the side of the toe, the incision being carried down to the periosteum, and **closes the wound by suture**. This draws the overlapping exuberant granulation tissue away from the nail.

T. L. Deavor excises a V-shaped section from the root of the nail, in the center, turning back the soft parts in all directions and exposing the limitations of the nail. The nail is removed, and, by **cutting and scraping**, the **nail-bed and matrix** are

cleared of all tissue down to the periosteum.

W.

MYXEDEMA. See **THYROID GLAND, DISEASES OF.**

NAPHTHALENE AND ALLIED COMPOUNDS.

—Naphthalene (naphthalenum; naphthalin; white tar; tar-camphor; mineral camphor; "moth balls") is a hydrocarbon [$C_{10}H_8$] obtained from coal tar. It occurs in white scales or powder, with a burning, aromatic taste. It is soluble in alcohol, chloroform, and ether, the fixed and volatile oils, and acetic acid, but it is insoluble in water. It melts at 175° F. (79° C.), and volatilizes slowly at ordinary temperatures, more rapidly when heated. When ignited it is consumed, leaving no residue; its vapor burns with a smoky flame. It should not give any reaction on moistened blue litmus paper, and should dissolve in concentrated sulphuric acid, when warmed gently, without color.

DOSE.—*Naphthalenum*, U. S. P. VIII (naphthalene), may be given in doses of 2 to 15 grains (0.13 to 1 Gm.) in powder or in capsule. The official average dose is 2 grains.

PHYSIOLOGICAL ACTION.—Locally, in the human subject, naphthalene temporarily irritates the mucous membranes; this effect becomes more marked when the drug is dissolved in oil or alcohol. Naphthalene is an antiseptic, though, according to some, this property is less marked than in the case of its derivatives, alpha- and beta-naphthol.

Given experimentally in large amounts to the lower animals, naphthalene causes diarrhea and emaciation, the latter due either to disturbed gastrointestinal functioning or to the parenchymatous nephritis which is soon also induced. Peculiar changes in the eyes, including subretinal effusion, bright points or yellow plaques on the retina, atrophy of the optic nerve, and progressive clouding of the lens, have been observed, and, according to V. d. Hoeve, prolonged use of the naphthols in man may cause an incipient retinal degeneration. Being partly oxidized in the body, naphthalene appears in the urine as alpha- and beta-naphthol and naphtho-

quinone, all in combination with glycuronic and sulphuric acids (Cushny). A brownish discoloration of the urine may result from the presence of these substances and their derivatives.

UNTOWARD EFFECTS AND POISONING.—Otte, after ingesting 8 grains (0.5 Gm.) of naphthalene (subsequently found pure on analysis), suffered from abdominal pain, diarrhea, tenesmus, protracted vomiting, sharp kidney pains, and slow pulse, continuing to be ill for five days. Though perhaps a case with unusual idiosyncrasy, this result imposes some degree of caution in the use of large doses. An eruption simulating that of measles, and followed by desquamation, has also been observed after the use of naphthalene.

THERAPEUTICS.—The therapeutic value of naphthalene depends upon its antiseptic and antiparasitic properties.

As intestinal antiseptic it has been used. In 5-grain (0.3 Gm.) doses, with apparent benefit in **typhoid fever** (Wolff), in **acute and chronic intestinal catarrh**, in **fermentative diarrhea**, and in **cholera**. It diminishes the activity of the intestinal bacteria, as shown by C. Sehrwald, who advises its use in conjunction with calomel. In **dysentery** 10 or 15 grains (0.6 to 1 Gm.) may be given in a warm decoction of althea (marshmallow) by rectal injection. In the **summer diarrhea** of children, $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.01 to 0.015 Gm.) may be given every two to four hours.

Naphthalene in doses of 3 to 10 grains (0.2 to 0.6 Gm.), combined with castor oil and disguised with a couple of drops of oil of bergamot, is useful in treating **ascarides** (Mirowitch). **Seat-worms** (*Oxyuris vermicularis*) can be well treated by the injection of 10 or 15 grains (0.6 to 1 Gm.) of naphthalene in 2 or 3 ounces (60 to 90 c.c.) of oil into the rectum. Bosini even recommends the administration of 22 grains (1.5 Gm.), after purgation, preferably with calomel. Schmitz states the dose for children as ranging from $2\frac{1}{4}$ grains (0.15 Gm.) for a child $1\frac{1}{2}$ years old to 6 grains (0.4 Gm.) for one of 12 or 13 years. He first gives a purge, then 4 doses of naphthalene daily for two days; this is then repeated twice at weekly intervals. For **tape-**

worm, 15 grains (1 Gm.) should be given before eating, followed some hours later by a full dose of castor oil.

In **pyelitis** and **cystitis** the drug lessens bacterial pullulation in the urine. Caution should be observed, however, in administering the drug where the renal parenchyma is diseased.

Chavernac has advised the use of naphthalene by vaporization in **pertussis**. The drug may be heated in any convenient vessel; care being taken to prevent its catching fire. Rossbach commends the use of naphthalene as an expectorant in **chronic bronchitis**, given in pills, powders, or troches, and for irrigation of the nasal cavities.

Scabies is cured by the use of a 10 to 12 per cent. solution of naphthalene in olive oil or linseed oil (Fürbringer). In an ointment (5 to 10 per cent.) it is useful in **chronic eczema**, **psoriasis**, **lupus vulgaris**, etc. It has a reducing action nearly as strong as that of ichthyol and sulphur, and may be tried in all cases where these are applicable.

As a dusting powder (with $2\frac{1}{2}$ per cent. of bergamot oil to cover the odor), as a spray, or on gauze, it is useful in the treatment of **abscesses**, **ulcers**, and recent or suppurating **wounds**. Dusted into the shoe or stocking, it has been found useful in **hyperidrosis** of the feet.

In the treatment of **insect bites** rubbing the parts every few hours with 2 or 3 drops of a saturated solution of naphthalene in liquid petrolatum is recommended.

NAPHTHOLS.

The naphthols are closely related chemically to naphthalene, from which they are formed by the substitution of one hydroxyl group (OH) for one hydrogen atom, their formula being thus $C_{10}H_8O$. During the process of manufacture two naphthols are formed, the official betanaphthol being the first to crystallize and being readily separated from the alphanaphthol by boiling alcohol, in which the latter is insoluble. Betanaphthol has already been discussed (see Vol. II). **Alphanaphthol**, which is not official, is considered to be one and a half times as strong as regards its antiseptic and germicidal powers, and it is not often used internally. Its dose and therapeutic uses

are practically the same as those of naphthalene. According to Maximowitsch, alphanaphthol is superior to the beta compound for intestinal antiseptic purposes, having an antiseptic power 3 times as great and being only one-third as toxic. The latter statement, however, may be erroneous, as the toxicity of alphanaphthol is considered by many to be greater than that of the official naphthol.

SODIUM BETANAPHTHOLATE (microcidin) $[C_{10}H_7ONa]$, made by the action of sodium hydroxide on betanaphthol, occurs as a yellowish-gray or white powder, soluble in 3 parts of water. It possesses strong antiseptic properties, and may be used in 0.3 to 0.5 per cent. solution in diseases of the ear, nose, and throat, and in 3 to 5 per cent. solution as a surgical antiseptic for instruments, bandages, etc.

BETANAPHTHOL BENZOATE (benzonaphthol; benzoyl naphthol) $[C_{10}H_7.C_7H_5O_2]$, a combination of benzoic acid and betanaphthol, occurs as a whitish powder which darkens with age. It is soluble in alcohol, but not in water. It is antiseptic and diuretic in doses of 4 to 8 grains (0.26 to 0.52 Gm.). With equal doses (2 grains—0.13 Gm.) of bismuth salicylate and $\frac{1}{2}$ grain (0.032 Gm.) of Dover's powder it has been recommended by S. Solis-Cohen in cases of **infantile diarrhea**. Benzonaphthol is said to be devoid of the irritant properties of betanaphthol. Naphthol is slowly liberated from it in the intestine.

BETANAPHTHOL DI-IODIDE (iodonaphthol; di-iodobetanaphthol; naphthol-aristol) $[C_{10}H_6I_2O_2]$ is a combination of iodine and betanaphthol. It occurs as a greenish-yellow, tasteless and odorless powder, soluble in chloroform, slightly soluble in alcohol, ether, and acetic acid, and insoluble in water. It has been used chiefly as an antiseptic dusting powder on **wounds** and **ulcers**.

BETANAPHTHOL SALICYLATE (betol; naphthalol; salinaphthol) $[C_6H_4.OH.COO.C_{10}H_7]$, a combination of betanaphthol and salicylic acid, occurs as a white powder without odor or taste, soluble in boiling alcohol and in ether, but insoluble in water and glycerin. It is used as an internal antiseptic, antizymotic,

and antirheumatic, in doses of 4 to 8 grains (0.25 to 0.5 Gm.), in wafers, milk, or emulsion, four times daily.

NAPHTHOL-CAMPHOR (camphorated betanaphthol) is a mixture of 1 part of betanaphthol with 2 parts of camphor, and occurs as a clear, brown, syrupy liquid, soluble in alcohol. It is recommended as an application for superficial tuberculous affections, and, when mixed with oil, in the treatment of *ozena*, *coryza*, *scabies*, and *furuncles*. It dissolves the fixed and volatile oils, alkaloids in general, and iodine (Deséquelle).

W. and S.

NASAL CAVITIES AND NASOPHARYNX, DISEASES OF. See NOSE AND NASOPHARYNX, DISEASES OF.

NEPHROLITHIASIS. See KIDNEYS, DISEASES OF.

NERVES, PERIPHERAL, DISEASES OF.—The diseases to which any or all of the peripheral nerves are liable are: 1. Circulatory disorders. 2. Inflammation. 3. Degeneration. 4. Functional disorders. 5. Neoplasms.

The circulatory disorders of any importance are: (a) Ischemia. (b) Hyperemia.

(a) ISCHEMIA.

This is a frequent accompaniment of general anemic states, and is also seen as a result of obstruction of the blood-vessels of the nerves from atheroma or other cause, and also occurs with the vasomotor neuroses. The condition is chiefly of theoretical interest, since a positive diagnosis is always difficult and frequently impossible, the symptoms being various and oftentimes vague and lacking in characteristic features. Anemia is doubtless in some instances a cause of neuritic pains and neuralgias, and some of the pains and paresthesias accompanying the atheromatous

arterial changes of old age are doubtless due to this condition. Almost any of the ill-defined peripheral motor and sensory abnormalities of the nerves may at times be presumptively traced to anemia.

Total or complete, permanent or transient interference with the supply of blood to a peripheral nerve may entail serious functional disturbance and even degeneration of the nerve. Desplats and Baillet (*Arch. des mal. du cœur*, Aug., 1911).

Time has confirmed the theory that neuritis may be caused by waste products where deficient oxygenation and nutrition of a nerve prevails. Thus, the optic nerve may suffer from ischemia after severe gastric hemorrhages; severe polyneuritis may also be traced to excessive bleeding. Duhot (*Paris méd.*, Feb. 15, 1919).

Sajous, as far back as 1907, urged that the accumulation of wastes in nerves debilitated by exposure to cold, traumatism, etc., and the resulting ischemia was a prominent cause of neuralgia, neuritis, etc. The neuralgia or headache which begins early in the morning when the circulation is at its lowest ebb may sometimes be relieved merely by removing an extra pillow which by raising the head too high interferes with the gravitation of blood to the sensitive nerves. EDITORS.

TREATMENT.—The successful treatment of the condition is based upon a recognition of its primary cause, and is directed toward the removal of this cause, together with the use of general tonics and hygienic measures calculated to improve nutrition and circulatory activity, especially strychnine. In the aged and feeble, with diseased arteries, all remedial measures may fail.

(b) HYPEREMIA.

This condition likewise is only recognizable with difficulty, although the symptoms are somewhat more definite and characteristic than are

those of ischemia of the nerves. The most commonly observed symptoms are muscular weakness, tenderness or pressure along the course of the nerve; pain, darting, stabbing, or neuralgic in character, together with sensory perversions. A true neuralgia may have as its basis hyperemia of the nerves. The symptoms are, it will be seen, much the same as those of an early stage of neuritis.

ETIOLOGY.—The causes of hyperemia of the nerves are: Adjacent inflammations, mechanical injuries, exposure to cold; bacterial, alkaloidal, metallic, and other poisons; rheumatism, gout, and other diathetic diseases; in short, the causes which, when intensified or prolonged, cause neuritis.

TREATMENT.—The best results in treatment are obtained from cold applications, leeches, cupping, and counterirritation. Massage and hydrotherapeutic measures are beneficial in chronic cases. Of internal remedies, potassium iodide and preparations containing iron give the best results. Sodium bromide is efficient in most cases by reducing the sensibility of the sensory terminals.

NEURITIS.

Inflammation of the nerves is, in most instances, associated with more or less degenerative change in the nerve-fibrils of the affected nerves. When the morbid process involves the nerve-sheaths and connective-tissue structures in particular we have an *interstitial neuritis*, and the changes are chiefly inflammatory in nature. When the disease locates itself in the nerve-fibrils it gives rise to *parenchymatous neuritis*,—a condition partaking more of the character of a degeneration than of a true inflammation. In practice these

two morbid states are usually combined,—*diffuse neuritis*,—so that, as indicated above, the so-called “neuritis” embodies both inflammatory and degenerative changes. There are many named varieties of neuritis, based upon etiological differences, intensity of the disease, its distribution, etc., and much confusion results therefrom. The practically important varieties are the following:—

(a) Traumatic neuritis, resulting from direct mechanical injury to the nerve, as from blows, wounds, pressure, etc., or through central disturbances awakened by the traumatism, which in turn give rise to peripheral neuritis, with hysterical phenomena in some cases.

(b) Neuritis from exposure to cold, sometimes called rheumatic, on good ground, as a polyneuritis.

Three cases of acute polyneuritis for which no other cause could be discovered except exposure to cold and dampness. There was no fever and the patients recovered completely in from two to eight months. The Lasègue sign was pronounced in each case, that is, flexion of the thigh on the hip was painless. Mancini (*Riforma Medica*, Apr. 12, 1909).

Rheumatic polyneuritis is a well-defined clinical entity; it may be the work of the bacilli or the result of toxemia or exposure to excessive heat or cold. The symptoms are sensory, motor, and trophic, the first named being the most pronounced and often leading to the diagnosis of neuralgia or gout. The pains commence insidiously, at first merely a sensation of tension in a limb or over several nerve areas. At first there are intervals free from discomfort or pain, but the pains gradually become more continuous and increase in severity on changes in the weather or with fatigue. The nerves are not tender except at the

emerging points of the main trunks. Schulhoff (Med. Klinik, June 15, 1913).

(c) Neuritis caused by extension of disease from adjacent parts (tuberculosis, syphilis, bone disease, etc.).

(d) Forms of neuritis resulting from the presence of bacterial poisons in the blood, exemplified in the neuritis accompanying or following typhoid fever, malaria, variola, syphilis, diphtheria, etc.

Brachial neuritis following pneumonia has been reported only comparatively recently, while large numbers of cases have been published consecutive to typhoid, small-pox, scarlet fever, measles, acute polyarthritis, tuberculosis, erysipelas, mumps, epidemic meningitis, malaria, and influenza. There are only 6 cases on record in which the neuritis followed pneumonia, but he observed 3 typical cases of this metapneumonic brachial plexus neuritis, all encountered in the last three years. Biermann (Deut. med. Woch., Jan. 23, 1913).

(e) Neuritis resulting from the action of poisons introduced from without, such as alcohol, lead, arsenic, mercurials, opium, etc.

Case in which there were pseudotabetic features and loss of osseous sensibility hitherto unreported in this form of neuritis, though common in other forms of neuritis and in tabes. The cause was attributed at first to exposure to fresh paint containing white lead used in house painting, but it was afterward ascertained that it was due to arsenic introduced into a can of baking powder, probably with criminal intent. Byrnes (Jour. Amer. Med. Assoc., Mar. 20, 1909).

The liver derangement has much to do with the development of the polyneuritis; some toxic product normally taken care of by the liver is allowed to remain unmodified or is modified in some abnormal man-

ner, and it acts on the nerves, inducing the polyneuritis. The suggestion is tentatively advanced that the recent research on the peculiar sensitizing properties of fluorescent substances (Tappeiner and Hausmann) may explain the polyneuritis in these cases as the result of the action of urobilin in the blood, urobilin being a fluorescent substance. Hematoporphyrin might also be considered from this standpoint. In the lead poisoning case the polyneuritis was of the Landry type and the patient presented intense urobilinuria and urobilinemia. Eppinger and Arnstein (Zeit. f. klin. Med., Bd. lxxiv, No. 3-4, 1912).

(f) The endemic or epidemic form of neuritis, seen in tropical islands and seacoast countries, the well-known "beriberi" (see BERIBERI, Volume II).

(g) The neuritis accompanying certain skin eruptions or other trophic changes (see HERPES ZOSTER, Volume V).

Whatever the pathological nature or etiological origin of neuritis, if a single nerve or small group of adjacent nerve-trunks be affected it is called a *simple neuritis*. If a number of nerves in different portions of the body be simultaneously invaded there exists a *multiple neuritis*. The neuritis from mechanical injury, exposure to cold, and other local causes is usually simple; the general infections, drug poisonings, and other toxemias give rise most often to multiple neuritis. Of course, there are exceptions to these rules, since a general toxemia may produce only localized effects—a simple neuritis—and a mechanical injury may involve a large nerve-trunk or several large nerves and give the symptoms of a multiple neuritis, as has been seen in cases of pressure upon lumbar and sacral nerves of

a large aneurism. A simple neuritis is usually *interstitial*; a multiple neuritis is apt to be chiefly *parenchymatous*.

SIMPLE NEURITIS.—A simple or localized neuritis arises from exposure to cold, involving in such cases nerve-trunks which lie near the surface of the body, the most frequently observed clinical form being *Bell's paralysis*, or *facial paralysis*, from traumatism,—blows or wounds; pressure, as from morbid growths; aneurisms, sleeping upon arms, crutches used long or injudiciously (*crutch paralysis*), and from tuberculous or other disease which involves the nerves by extension from adjacent affected parts.

There are certain nerve affections, neuritis and hyperesthesia of the vulva and vagina, which are not sufficiently recognized by the average practitioner. The patient is generally a neurasthenic or neurotic and is usually suffering from associated disease, which is often due to impaired function rather than to organic change. There is tenderness and occasional swelling of the parts, and painful micturition. They are usually treated for some slight apparent erosion. I. S. Stone (Jour. Amer. Med. Assoc., Oct. 9, 1909).

There are in the literature, including the writer's personal observation, 136 instances in which the femoral nerve has been the seat of an inflammatory process originating from some internal disorder. The disease has been observed 84 times as a post-partum complication, once as a congenital affection, 8 times as a primary condition, and 3 instances have been referred to which the writer has been unable to verify. The remaining 40 cases are distributed among 15 different disorders. In a few instances the inflammation has extended to adjacent nerves, but in each case the most pronounced symptoms have been confined to the femoral distribution. The onset of

the disease may be acute or subacute. The commonest and earliest symptom is pain in the distribution of the crural nerve or one of its neighboring branches. In the course of a week, or even a month, if the onset be subacute, the pain becomes more persistent, of wider distribution, greater intensity, and of a continuous paroxysmal nature with nocturnal exacerbations. The character, location, and extent of the pain are quite distinctive. Except in the mildest cases, there is always some motor disturbance. Weakness and "giving way" of the knee are common complaints, and there is some difficulty in raising the leg from the bed when the knee is fixed. There is usually moderate wasting of the muscles on the front of the thigh. The superficial reflexes, epigastric and abdominal, may or may not be altered. Slight electrical changes are usually to be found in the muscles of the affected side. Byrnes (Jour. of Nerv. and Mental Dis., Jan., 1914).

Symptoms.—The symptoms of simple neuritis vary with the cause, nature, and location of the disease, but the true neural symptoms are essentially the same in all, consisting in perversion, exaltation, or, it may be, entire abolition of function of the nerves involved. There is usually pain, of a stabbing, darting character, felt in the parts to which the nerve is distributed, with some pain and tenderness along the course of the nerve. This pain is partly due to pressure or irritation of the *nervi nervorum*, and may be very intense and distressing or may, as is often the case in mild forms of neuritis, cause little or no inconvenience. There is occasionally edematous swelling and redness of the skin over the point of greatest inflammatory activity, and trophic cutaneous affections, sweating, and swelling of, and effusions

into, joints sometimes appear. Tactile sensation is impaired in the affected area, and numbness and formication are frequent. Weakness in the muscles supplied by the affected nerves is the rule, reaching in the severer cases a complete paralysis. Muscular twitchings and spasmodic contractions are sometimes noted. In the severe and long-continued cases there is apt to be great atrophy of the affected muscles, which may be followed by contractures of fingers or toes or other parts involved. The nutrition of the hair and nails is often defective, leading to falling out or grayness of hair, deformities or dropping away of nails, etc.

Case in which a prophylactic injection of 10 c.c. (2½ fluidrams) of antitetanic serum, following a similar injection given four years before, caused an immediate local urticarial and inflammatory reaction, and later (nine days after the injection) alternating attacks of general urticaria and cardiac weakness, lasting for two days, and accompanied by vomiting, diarrhea, oliguria, albuminuria, and rapid loss of strength. Although the condition seemed critical, quick recovery followed. Two weeks later there developed on the side of the injection paralysis of the serratus magnus and other muscles, with rapid wasting. The phenomena of serum intoxication and anaphylactic shock seemed to coexist. Thaon (*Revue de méd.*, Sept., 1912).

The electrical reactions in simple neuritis vary with the intensity of the disease, being in the milder cases nearly or quite normal, but showing in all of the severe forms a partial or complete reaction of degeneration.

The duration of a simple neuritis depends chiefly upon the severity or curability of the initial lesion. The symptoms may pass off in a few days,

or may persist for months. Recovery is the rule, and is always obtained, provided the cause is one which can be removed. In very unfavorable cases some permanent contracture or paralysis may result.

Pathology.—In simple neuritis the changes are chiefly localized in a limited portion of the nerve-trunk, only the degenerative changes in nerve-fibers, where such a parenchymatous lesion is present, extending along the entire distal portion of the nerve. At the point of injury the nerve-trunk is red, swelled, and infiltrated with lymphoid elements, and may be surrounded by a gelatinous exudate. The changes involve especially the perineural and interstitial connective-tissue framework. In mild cases the nerve-fibrils themselves are slightly, if at all, involved; in severer cases, or where the fibrils have undergone compression from swelling of connective-tissue structures, the nerve-fibrils show the alterations of parenchymatous neuritis; their myelinic sheaths are fragmented, the nuclei of the sheath of Schwann and of the internodal cells are increased in number, or may seem swelled; in still more severe cases the axis-cylinders show marked degenerative alterations, become varicose, swell, disintegrate, and even entirely disappear, the appearances being then nearly identical with those of a true Wallerian degeneration. These changes in the axis-cylinders necessarily involve all of the nerve-fibers lying below the seat of injury, but are usually arrested at the first node of Ranvier above, although in some cases they may extend upward, even quite to the cord. The blood-vessels at the seat of an injury are

often distended, and minute hemorrhages into the nerve are of not infrequent occurrence. The disease may go on to complete destruction of the nerve-elements, the degenerated fibers being replaced by connective tissue and by fat-cells: a condition, when the fat-deposits are abundant, called by Leyden "lipomatous neuritis." Regeneration begins after a short time, and, if the original nerve injury be removed, the nerve may, even in very severe cases, ultimately regain its former healthy state.

Treatment.—As a necessary preliminary to any treatment, the cause of the disease must be removed. After this, **rest** of the affected part, absolute and continued for several days, should be insisted upon. The application of **splints** to limbs is sometimes advisable. **Heat**, especially **moist heat**,—as from steam, poultices, or fomentations,—gives great relief from the pain. **Counter-irritation** by **mustard plasters** or other means is sometimes equally efficacious. In many instances the **galvanic current** used in strength sufficient to redden the skin gives immediate and wonderful relief. Occasionally in early stages **ice** locally applied will give more relief than anything else. Of internal remedies, **phenyl salicylate**, **aspirin**, the **salicylates**, and the whole series of coal-tar derivatives—in particular, **antipyrin**, **acetphenetidin**, and **acetanilide**—may be used in the confident expectation of obtaining measurable relief from the pain.

Series of 32 cases treated with **nitroglycerin** after the method suggested by Krauss, of Buffalo. Beginning with $\frac{1}{100}$ grain (0.0006 Gm.) every eight hours the interval was reduced one hour in every twenty-

four until the full physiological action of the drug was manifest, or the patient was taking $\frac{1}{100}$ grain (0.0006 Gm.) every three hours, at which interval it was continued. **Sodium bromide** controls the flushing and headache. In acute cases the effect was marked within forty-eight hours. In chronic cases **ammonium** and **potassium iodide** in progressively increasing doses hastened the action of the nitroglycerin. The **actual cautery** was also used over the nerve. Stevenson (Med. Rec., May 16, 1908).

For pain, especially that associated with rheumatic or gouty cases, the following mixture is recommended:—

R Antipyrin,..... gr. v-x (0.3-0.6 Gm.).

Sodium salicylate . gr. x (0.6 Gm.).

Caffeine citrate.... gr. v (0.3 Gm.).

Aromatic spirit of ammonia f3ss (2 c.c.).

Chloroform water,

q. s. ad..... f3ss (15 c.c.).

For the artetiosclerotic cases a mixture containing **nux vomica** and **potassium iodide** is often very effective. **Acetylsalicylic acid**, gr. xv (1 Gm.), is often very useful in the milder cases. Howell (Pract., Mar., 1914).

When other remedies fail the local hypodermic use of **morphine** is, where pain is very intense, justifiable. The early use of mercurials—**calomel** or **blue mass**—is often attended by good results. In any case the bowels should be kept open by **salines** or a simple **purgative pill**. Attention should be paid to the general health. In most instances **tonics** and **alteratives** will be found beneficial.

The benefit from deep injections of **alcohol** in neuritis and neuralgia is extolled as a substitute for removal of the Gasserian ganglion, as the toxic degeneration that follows the injection answers practically the same purpose as gasserectomy. The writer's experience confirms the possibility of subsequent toxic degenera-

tion of the nerve; on this account the method should not be applied to motor or mixed nerves except as a last resort. He treated 12 patients with severe sciatica by local injection of alcohol, and 8 were either entirely or nearly cured, but 1 patient developed complete paralysis of the peroneus nerve, which persisted complete for nine months and then gradually subsided in the course of the next three months. Erb had a similar experience in 3 cases in his private practice. In 3 out of these 4 cases of toxic degeneration the symptoms gradually abated, but the return of the neuralgia kept pace with this. With all its advantages, therefore, the method has its drawbacks. Fischler (*Münch. med. Woch.*, Aug. 6, 1907).

The galvanic current has proved more satisfactory in the writer's hands than any other modality, but the benefits following its use are not usually great, and, unless much care is exercised in its administration, it, too, may aggravate the symptoms. But **phototherapy** has given far better results. In addition to its power to relieve blood-pressure and pain, its bactericidal properties, its influence as a promoter of tissue metabolism, and its power to increase the hemoglobin-carrying power of the red corpuscles render it of value in a variety of constitutional conditions. See **HELIO THERAPY**, this volume. Rockwell (*Med. Rec.*, Nov. 9, 1907).

Hot-air applications accomplish two equally important objects: they alleviate the pains, which are the principal symptom of the disease, and at the same time they cure the disease itself. The cure is effected most likely by the production of an active hyperemia not only in the skin to which the heat is applied, but also in the underlying tissues, including the affected nerve-trunks. After an application the skin is very much reddened, and at the end of a week the area is browned as from sunburn. The process of repair is stimulated and the course of the disease consid-

erably shortened. In the milder forms of the disease, which are fully as common as the severer forms, the hot-air treatment is as near an approach to a specific as we could wish for. Stieghtz (*Med. Record*, July 8, 1911).

The writer places long electrodes consisting of absorbent cotton wrapped in gauze parallel in pairs along limbs or spinal column. The current is transmitted through metallic bands of suitable length, intensity of current being 60 to 80 milliamperes for an arm and 100 to 125 for a lower limb. The sitting should last three-quarters to one hour, and be frequently repeated. The method was used in nearly 600 cases, with excellent results. Traumatic myelitis benefited. Hirtz (*Semaine méd.*, May 28, 1913).

The writer found **cataphoresis** of the very greatest use in relieving pain and shortening the attack in cases of rheumatic or gouty origin. The drugs introduced are either 2 per cent. **sodium salicylate** or **iodine**. For the former the cathode is used, for the latter the anode. It is preferable to have the arm treated by **hot air** or **hot compresses** before ionization is begun; the object of this is to get the skin thoroughly moist, thus enabling large currents to be used painlessly, whereby the entrance of the iodine or salicylic acid ions is facilitated. The limbs should be **kept warm** by being wrapped in wool and the weight of the arm supported by a sling. Howell (*Pract.*, Mar., 1914).

After subsidence of the acute stage and after all tenderness, redness in skin, pain in parts, etc., have disappeared, systematic **massage** and the use of **faradic stimulation** to the muscles will hasten restoration of function in muscles and cutaneous surface. The presence of varicose veins in the affected limb indicates the need of support, such as an **elastic stocking**.

A simple and most satisfactory treatment is to map out the tender spots along the affected nerve. A pledget of cotton firmly compressed into a ball the size of a knuckle is then saturated with fuming hydrochloric acid. A strip $1\frac{1}{2}$ inches wide is then painted with the acid along the painful area. The slight smarting produced passes off in a few minutes and the skin is not harmed. This is repeated twice a week until pain and tenderness cease. Saintsbury (Lancet, June 16, 1917).

MULTIPLE NEURITIS, OR POLYNEURITIS.

DEFINITION.—This disease (also termed disseminated neuritis and peripheral neuritis) is a parenchymatous neuritis affecting many peripheral nerves at or about the same time.

VARIETIES.—Numerous varieties and forms of multiple neuritis are recognized, and of these the more important have received distinguishing names, as mentioned below. The varieties, as in the case of simple neuritis, arise from differences in nature, causation, severity, and location of the morbid process. The causes of multiple neuritis are: bacterial infection, toxic substances in the blood, anemia, and dyscrasic states; in short, any state of toxemia or malnutrition.

SYMPTOMS AND DIAGNOSIS.

—The disease may come on suddenly and reach its greatest intensity within a few days (acute bacterial infections), or may show a slow and insidious onset (alcoholic and cachectic forms). The characteristic and ever-present features of the clinical picture are the abnormalities of nerve-reaction: *i.e.*, alterations in sensory, motor, reflex, and trophic function of the nerves involved.

The writer has observed at the front and in civil life an acute, severe form of widespread polyneuritis. The onset is generally rapid with malaise or fever and no local manifestations. The pains develop in the legs and lower part of the back, usually on the second or third day, and persist. Weakness begins in the legs usually a day or so later. The paresis increases rapidly and the upper extremities affected. At about the same time the patients complain that their faces are drawn and stiff and there may also be some interference with power of articulation or swallowing. In the established disease symptoms are characteristic. The lower extremities are equally affected, flabby, without tone, and extensively paralyzed. The paralysis is seldom complete in all groups of muscles and all are often more or less uniformly affected. The feet are dropped; there may be no movement possible at the toe and ankle joints, but there is nearly always some at both hip and knee. The arms are similarly but less severely affected. The muscles of the trunk are less seriously involved than the arms, though there may be some paresis of the respiratory movements. The deep reflexes are absent. The picture closely resembles a generalized peripheral neuritis of the motor nerves. There is relatively little sensory affection, though some pain may be complained of. The sphincters are usually more or less disturbed. Vasomotor, sensory, and trophic disturbances do not occur. The course of the affection is rapid and restoration of function is usually steady and rapid. Gordon Holmes (Brit. Med. Jour., July 14, 1917).

The extraneural symptoms vary with the cause and nature of the initial morbid impulse. In the typical acute "idiopathic" cases and in cases accompanying acute infectious diseases the attack comes on with fever and the other usual features of the onset of an acute infectious malady.

A chill may be the first indication. Headache and aching in the back and limbs are frequent, as are also loss of appetite, furred tongue, constipation, and other evidences of gastrointestinal disturbance. The real nature of the case may be obscure for the first few days, but within this time the true neuritic symptoms make their appearance, and all doubt is quickly removed.

Pain along the course of the nerves in legs or arms, or both, is noted, with tenderness in the muscles as well as in the nerve-trunk. Perversions of sensation now appear, in the form of tingling, formication, diminution in tactile sense, or hyperesthesia or in rare cases anesthesia. In addition to the above-mentioned tenderness on pressure the muscles in the parts affected become relaxed and flabby; there is weakness or even in severe cases complete paralysis. This muscular weakness begins most frequently in the legs, extending upward by degrees, reaching the arms; usually these become affected some time after the symptoms in the legs are well established. In many cases typical *wrist-drop* and *foot-drop* are shown.

The paralysis may reach the muscles of phonation, deglutition, and respiration, resulting in some degree of impairment of these functions. In severe cases, especially in those of rapid onset, the pneumogastric nerve may be involved, resulting in marked tachycardia. Trophic disorders are also of frequent occurrence, such as edema, glossy skin, and herpetic eruptions in the area affected. The tendon-reflexes are usually diminished or abolished. In all save the milder cases there are changes in the

electrical reactions similar to those of simple neuritis. The muscles lose their faradic excitability and with the galvanic current show a slow, worm-like contraction, with anodal closure contraction greater than the reaction to cathodal closure.

The intensity, rapidity of onset, course, and duration of multiple neuritis vary considerably in different cases. In some the pain is scarcely noticeable, the motor symptoms predominating. In mild cases there may be only slight stiffness or weakness of the muscles, passing off in a few days. In other cases the pains are violent and excruciating, and the paralysis of the muscles is total and long continued, months elapsing before the patient regains use of the paralyzed limbs. Deaths are not infrequent, occurring during the acute stage from failure of respiration or heart-action, and in the chronic stage from exhaustion or intercurrent complications, as pneumonia, pleurisy, or tuberculosis.

In cases of multiple neuritis from other causes than acute bacterial infection there are few constitutional symptoms, a more gradual onset, and a greater chronicity. The diagnosis, also, is easier, since the neural abnormalities are not masked to such an extent by the symptoms of acute disease.

It should be remembered that the characteristic symptoms of multiple neuritis and those upon which a diagnosis must rest are the motor, sensory, reflex, and trophic nerve disorders; the gastrointestinal, cardiac, respiratory, and other occasional features may or may not be present, and to the symptoms of any multiple neuritis may be added the complicat-

ing clinical picture of some acute disease to which the neuritis is possibly due. If the nerve reactions are tested for, there will be little danger of error in diagnosis. In the acute cases of sudden onset in which tachycardia and respiratory distress, with general edema, pallor of surface, loud heart-murmurs, etc., are present the peripheral nerve disorders are masked, and the case is liable to be regarded as one of acute "heart-failure" or "Bright's disease" unless careful tests are made for neural symptoms. Chronic cases resemble in many particulars tabes dorsalis; the characteristic gait, the lightning pains, girdle sensation, and absence of muscular weakness in tabes ought, however, to render a diagnosis easy.

Clinically, multiple neuritis may simulate a spinal atrophy as regards distribution of paralysis, absence of sensory symptoms, and protracted course. Progressive spinal muscular atrophy may resemble neuritis in the presence of pain, remission of symptoms, and subacute course. Etiology and course are still the best guides in the clinical diagnosis of the various muscle atrophies. J. Grinker (Jour. Amer. Med. Assoc., Mar. 9, 1907).

The onset and course of acute anterior poliomyelitis are not unlike those of acute peripheral neuritis. The fact that the former occurs in children, the latter in adults, and the absence in poliomyelitis of the marked sensory symptoms of neuritis are sufficient distinguishing points in the vast majority of cases.

The disease is of frequent occurrence, coming often within the notice of both the neurologist and general practitioner of medicine. The alcoholic, syphilitic, postfebrile, and toxic forms are common in all climates. In

the southern United States malarial and idiopathic forms are often seen.

PATHOLOGY.—One has to deal in multiple neuritis with a general toxemia or nutrition deficiency in the blood, causing degenerative changes in the nerve-fibers of the peripheral nerves, associated in some instances with such inflammatory changes as were described under simple neuritis. The peripheral ends of the nerve-threads, being farthest removed from the trophic center (the cell-body), show the first and most pronounced changes. In severe cases the entire cell may become involved or be destroyed. The anatomicopathological changes are similar to those described under simple neuritis.

TREATMENT.—The treatment of multiple neuritis should first be directed toward the removal of the cause and the relief of the pain and acute symptoms; after this, measures which hasten regeneration of nerve- and muscle- fibers are indicated. In idiopathic cases a full dose of **calomel**, followed by a **saline**, is beneficial. **Intestinal antiseptics** also aid. The pains are controlled by **hot applications**, dry or moist, and by **aspirin**, the **coal-tar derivatives**, and **opium**. After subsidence of the acute stage, **massage** and rubbings of affected parts, with **faradic electricity**, give the best results in hastening regeneration. Systematic **exercise** should be advised as soon as the condition of the muscles permits of it. Tonic doses of **strychnine** and **arsenic** seem to hasten recovery. In the distressing cases in which tachycardia is a prominent symptom all heart stimulants are apt to prove of no avail, the best results being obtained from **cold applications to the chest**. In the

paralytic cases where, after long-continued helplessness, contractures and permanent deformities are threatened, **passive movements** and, if need be, **fixation of limbs** by means of properly adapted **splints** may be required.

The more important varieties of multiple neuritis are the following:—

Syphilitic Neuritis.—This occurs as a result of syphilitic infection. The onset is afebrile and insidious, acute, active symptoms being wanting. The course is chronic. Some cases resemble tabes (*syphilitic pseudotabes*).

There is a syphilitic polyneuritis which appears in the secondary stage of syphilis, most frequently early, and usually associated with specific symptoms in the skin and mucous membranes. The occurrence of a syphilitic polyneuritis in the tertiary or metasymphilitic stage cannot be demonstrated. Steinert (Münch. med. Woch., Sept. 28, 1909).

Treatment.—The cure is effected through removal of the syphilitic poison by **salvarsan**, **mercury**, **iodides**, **hot baths**, **massage**, and **electricity**.

Alcoholic Neuritis.—Caused by chronic alcohol poisoning. Gradual onset, without fever or disturbance of general bodily functions. Chronic course. Cure usual, through **removal of cause**.

Arsenical neuritis, **saturnine neuritis**, and other related forms are due to injudicious or excessive use of arsenic, lead, or other similar drug.

These are readily curable through **removal of the cause**.

Postfebrile neuritis, following typhoid or other fever, **diphtheritic neuritis**, **scarlatinal neuritis**, etc., are caused by the poisons of these infectious diseases. The neural symptoms are complicated by the features of the associated germ disease. Disappear-

ance of the acute disease is followed by recovery.

Malarial neuritis occurs in malarial localities, not always accompanying or following malaria, but occurring in some persons in a community while others suffer from malaria. The onset, course, clinical picture, and terminations are similar to those of the idiopathic forms. It resembles beriberi in some particulars.

Neuromyositis.—Senator in 1888 (Deut. med. Woch., xiv, 499, 1888) first used this term to distinguish cases presenting symptoms of both neuritis and myositis. While only a few instances of this condition have been recorded, the majority have been in alcoholics and it is still an open question as to whether the condition is a clinical entity or merely a coincidental happening of two separate conditions.

The nervous symptoms are those of a multiple neuritis and seem to have been more prominent than the muscular symptoms, which vary from tenderness to swelling and pain on movement.

Characteristic features are tenderness over the nerve-trunks, sensory losses, loss of reflexes, ataxia, and muscular atrophy.

Tuberculous neuritis, **rheumatic neuritis**, **septicemic neuritis**, **diabetic neuritis**, and many other forms are spoken of by writers. Their nature is sufficiently indicated by the name.

Pregnancy and Parturition Neuritis.—This form has received increased attention of late.

Lumbar neuritis was observed in 32 out of 680 parturients at Leopold Meyer's Maternity at Copenhagen. The symptoms were tenderness of the nerves of the leg, paresis, pains, hyperesthesia of the skin, and in

some cases exaggeration of the knee-jerk. The symptoms observed indicate that this extremely severe puerperal lumbar neuritis is due to puerperal intoxication, inducing transient inflammation of the nerves connected with the lumbar plexus. Hauch (*Zeit. f. Geb. u. Gynäk.*, Bd. lvii, Nu. 2, 1906).

Sixteen cases of myelitis or polyneuritis occurring in the course of toxic vomiting in pregnant women. In each case in which the pulse is recorded the rate had been over 100 before the signs of paralysis developed, confirming the necessity for active measures whenever the pulse runs over 100 in the vomiting of pregnancy. Five of the women died; 6 were delivered at term, but most were left with severe functional disturbances. In 5 cases the gravity of the symptoms led to early interruption of the pregnancy and the outcome was by far the most favorable in this group. L. Job (*Annales de gynéc. et d'obstet.*, Mar., 1911).

In several cases of puerperal neuritis or polyneuritis which the writer had published, the neuritic process developed in the puerperium and there was no tendency to fever nor suppuration; delivery had been normal. In 2 other cases epileptic seizures developed during the pregnancy or reappeared after years of latency. In 2 other cases a maniacal psychosis developed in the course of a pregnancy. In both of these as well as in the epileptic cases the women recovered after the pregnancy had been interrupted. Many women would be saved from chronic mental disease if abortion were induced in time when the mental disease first develops in connection with a pregnancy. Saenger (*Münch. med. Woch.*, Oct. 8, 1912).

Endemic neuritis, or beriberi, caused probably by specific bacterial infection, is rarely seen save in the tropics, near the seacoast. (See BERIBERI in Volume II.)

Analysis of 963 cases of peripheral neuritis treated in a railway hospital in north Brazil. The writer concludes (1) that a peripheral neuritis attended by high mortality prevailed in north Brazil; (2) that this neuritis was a clinical entity which must be classified as beriberi or as a member of an as yet hypothetical beriberi group; (3) that this disease bore no intimate relation to the consumption of rice as a staple article of diet; (4) that it was not due to the absence of any food principle in the diet of those whom it attacked. That this disease was not intimately associated with a rice diet, and that it was not due to the absence of any of the recognized food elements, was self-evident. The mortality was from 15 to 20 per cent., and anatomically there were atrophy of the skeletal muscles, dilatation and hypertrophy of the heart, and effusions into the serous cavities, particularly the pericardium. Frequently the whole cadaver was waterlogged. C. Lovelace (*Texas State Jour. of Med.*, July, 1913).

Enterogenous Multiple Neuritis.—Autointoxication of intestinal origin is undoubtedly a prominent factor in many cases.

There is a form which should be termed enterogenous polyneuritis. In regard to enterogenous intoxication we know much. The ordinary cleavage products of tryptic digestion comprise substances essentially toxic and we do not understand why we are not more frequently poisoned by them. Further, the bacterial intestinal flora induce the formation of known toxic substances from the protein of the diet. The actual causes of enterogenous poisoning are: Constipation, with habit of taking purgatives (the bowels sometimes move daily of themselves); accumulation of fecal matter in the sigmoid; hyperacidity, due apparently to the colonic atony; tenderness over sigmoid. When instead of constipation we find diarrhea this in no wise changes the

nature, for the diarrhea is purely a reflex from the irritation of the feces. It may assume the form of mucous colitis. The proctoscope in such cases shows the real nature of the condition. The chief somatic consequence of this condition is apparent in the absorption of some neurotrophic substance. Neuralgiform pains appear here and there, and in some instances the affected nerves are sensitive to pressure. The same pains may seem to affect muscles and joints and are always fugacious. Von Noorden (Berl. klin. Woch., Jan. 13, 1913).

Treatment.—The treatment of multiple neuritis resolves itself into removal of the cause, with rest in bed as an all-important adjunct. Pressure of the bed-clothes upon the affected areas should be avoided. Nutritious food is indicated where asthenia exists, but it should be remembered that polyneuritis may be caused by autointoxication of intestinal origin. When the urine shows an abnormal amount of acid alkalies are effective.

In the treatment of autointoxication neuritis the goal is reached most quickly in some cases with a pure milk diet or with modifications of milk, such as sour milk, yoghurt, kefir, etc. In other cases milk is most unsuitable. Farinaceous food or a mixed vegetable diet gives better results. In some cases it was found to be a decided benefit to have the patient take nothing for some days but a solution of sugar. There are cases in which an animal diet deserves the preference. Such a one-sided diet should, however, only be given for a short time, and later to accustom the intestine to a mixed diet. Cure does not occur until the intestines act regularly on ordinary diet, and until the entire lower section of the intestine is completely emptied at stool. Practically no drugs are used. Von Noorden (Jour. Amer. Med. Assoc., Jan. 11, 1913).

The writer recommends hot saline solution injections into the painful area, the amount injected varying with the location of the painful nerve. For the sciatic he injects 200 c.c. (6¾ ounces), for the anterior crural 50 c.c. (1½ ounces), etc. The needle is inserted first and if no blood appears, the syringe is attached after all air in it besides the fluid is carefully expelled. The injections are repeated as needed. The pain fails to recur in months, 2 years in one instance, when the injection will again promptly relieve. Alfred Gordon (Therap. Gaz., June 15, 1916).

The relief of pain should be insured by the use of anodynes locally and internally, belladonna and morphine being used jointly, but guardedly—hypodermically or directly into the most painful area. Hyoscine hydrobromide is also useful. The local application of adrenalin ointment or veratrine ointment or, again, hot lead water and laudanum may prove useful. Cocaine anesthesia produced as for surgical operations (see COCAINE, Vol. III, and HOLOCAINE, Vol. V) is sometimes necessary where the pain is extremely acute. The general measures indicated in simple neuritis may also be applicable, but the salicylates and the antipyrin products are not always efficient. This applies also to mercurials and the iodides unless the case be distinctly of syphilitic origin.

The subcutaneous injections of arsenic caused marked improvement or cure in 5 cases. The formula used was as follows: Sodium cacodylate, 1.5 Gm. (23 grains); cocaine hydrochloride, 0.1 Gm. (1½ grains); liquid phenol, 3 drops; distilled water, a sufficient quantity to make 50 c.c. (1¾ fluidounces).

The treatment began with 0.4 c.c. (7 minims), dose injected being increased by 0.1 c.c. (1¾ minims) daily

until 2 c.c. (32 minims) were reached; this amount was continued for two weeks, then reduced gradually to 0.4 c.c. Willige (Münch. med. Woch., Mar. 22, 1910).

Dry heat, wrapping the painful areas in cotton-wool pads, and warm baths as hot as can be readily borne have all given good results.

An important feature is to prevent dropping of the feet; these should be supported by splints or by sand-bags. **Postures** assumed for the relief of pain should be gently changed so as to avoid adhesions within the joints and invalidity.

In the polyneuritis due to alcohol, which affects mainly the extremities, the use of alcohol should cease at once and sodium bromide given to subdue the hyperesthesia of the sensory terminals.

FUNCTIONAL DISORDERS OF NERVES.

VARIETIES.—The functional disorders of the peripheral nerves may be classed as the motor, sensory, and mixed forms.

The motor functional neuroses of peripheral origin are:—

(a) **Recumbent palsy, night palsy, or waking numbness**, characterized by temporary paralysis of one or more extremities, is noticed after lying still for a time or upon awakening in the morning. The symptoms are much the same as those seen when a nerve is compressed, as when a limb “goes to sleep”; but are not caused by pressure, and should not be confounded with the pressure paralyses. It is a rare condition, occurs in neurotic subjects, and its causation and pathology are unknown.

(b) **Spasm and tremor**, occurring from overuse of muscles and fre-

quently associated with some form of **occupation neurosis**.

The peripheral sensory neuroses are:—

(a) **Neuralgia**, elsewhere described.

(b) **Paresthetic neurosis**, an affection closely akin to and sometimes associated with the waking numbness above mentioned. It is a condition of little practical importance.

NEOPLASMS OF NERVES.

Tumors growing in or upon the nerve-trunks are either *true neuromata*—i.e., tumors composed of medullated nerve-fibers or other nerve-tissue—or are *false neuromata*,—i.e., composed of other than nerve-tissue. The “false” neuromata are usually of secondary origin, i.e., extend to the nerve from adjacent structures, the most common kinds being fibroma, sarcoma, myxoma, and the syphilitic and tuberculous growths. They need not be considered here, attention being directed only to the true nerve tumors.

NEUROMA occurs singly or in numbers reaching into the thousands. When multiple, neuromata are usually small, and form shot-like, but quite painful nodules under the skin. When few in number they are apt to be larger in size, being occasionally an inch or more in diameter. The causes of neuroma are, in the multiple form, hereditary predisposition, and, in the simple form, injuries to the nerve-trunk from blows, surgical operations, etc. The knob-like masses which develop upon the ends of the nerves of the stump after amputation offer a good example of this form of neuroma.

Symptoms.—The symptoms of neuroma, beyond the presence of the tumor, are often *nil*. In some in-

stances, however, there is pain, paresthesia, or paralysis in the affected nerve area. Occasionally the pain is intense, distressing, and neuralgic in character, as is seen in *postamputation neuromata*.

Treatment.—No treatment is called for unless there is pain or other interference with nerve function, when surgical measures, usually a total excision, are called for and give relief.

When examined microscopically true neuromata are found to consist of nerve-fibers, medullated or non-medullated, with occasionally a few ganglion-cells interspersed, these nerve-elements being mixed with some fibrous tissue. When the fibrous tissue is abundant the growth is spoken of as *fibroneuroma*.

DISEASES OF SPECIAL NERVES.

The several conditions of general disease already described may, when involving special nerves, give rise to well-defined clinical symptom-groups meriting brief description.

Diseases of the nerves of *special sense*—the olfactory, optic, auditory, etc.—are dealt with by specialists and are, to a large extent, devoid of general interest. The affections of the optic nerve, of which neuritis is the most important, are of value in the diagnosis of intracranial lesions.

Disease of the third, fourth, and sixth pairs of cranial nerves leads to abnormalities of ocular movement, whose consideration falls within the domain of the eye specialist, although the lesions are often of value in diagnosis of brain diseases.

The most important disorders of the fifth cranial nerve are neuralgia and headache, elsewhere considered.

The seventh cranial nerve may be affected by spasm or convulsive tics, or by the not uncommon and clinically important "Bell's palsy," or facial paralysis.

FACIAL PARALYSIS.

This is a motor paralysis affecting usually the muscles of one side of the face.

SYMPTOMS.—The onset of a facial paralysis is usually sudden, or of rapid development, and is indicated by loss of power in the muscles of one lateral half of the face, with loss of emotional as well as of voluntary movements. The affected side is expressionless and smooth, the lower eyelid droops, and the eye cannot be entirely closed. The tears accumulate and run down the face. The lips are relaxed and powerless, and ability to drink, chew, articulate, etc., is impaired. The mouth is drawn toward the affected side, this and other evidences of paralysis being exaggerated when the patient laughs or smiles. The affected side may show some congestion or circulatory defect, and occasionally an herpetic eruption appears. The soft palate and tongue are not involved, although, on account of the displacement of the mouth, the tongue seems to deviate from the median line. The sense of taste in the anterior part of the tongue is lost in a small proportion of cases. There are few or no sensory abnormalities.

The electrical reactions are the same as are seen in other forms of peripheral neuritis, their exact character depending upon the severity of the case, and for this reason possessing an especial value in prognosis. Thus, if the electrical reactions are nearly normal the case is a mild one,

and recovery will most likely take place within a few weeks. If the excitability of the nerve to galvanic and faradic currents is lessened and that of the muscles to galvanic current increased and formula altered (An.Cl.C. > K.Cl.C.: contraction sluggish) the case is still favorable, recovery being probable within six to eight weeks. When complete reaction of degeneration is present,—that is, when faradic and galvanic excitability of nerve is lost, faradic excitability of muscle lost, galvanic excitability of muscle increased, and formula and nature of contraction altered as above,—the case is serious and will not recover for many months.

The usual outcome of a peripheral facial paralysis is complete recovery. In the few cases which terminate unfavorably the paralysis and resulting facial asymmetry may be permanent. There is atrophy of facial muscles in all severe cases, and some degree of atrophy as well as some contracture may, in the more serious cases, persist.

DIAGNOSIS.—The diagnosis of a facial palsy is simple, inspection being all that is required in the majority of cases. The only question is whether the lesion is central or peripheral. The peripheral cases show changes in electrical reactions, impairment of emotional movements, loss of reflex movements, and persistent paralysis of eyelid, these conditions being reversed in central paralysis. A central lesion also is usually associated with some other symptoms of intracranial disease, often a hemiplegia. The seat of the lesion can often be accurately located. If the facial nerve alone is involved and the sense of taste is unimpaired, the

lesion is in the trunk of the nerve, outside of the skull, or is just within the stylomastoid foramen. If the sense of taste in the anterior portion of the tongue is affected, the lesion is in the Fallopian canal. If complete deafness occurs with the facial palsy, disease in the trunk of the nerve at the base of the brain is indicated, while, if there is associated paralysis of the sixth nerve, the lesion is probably located in the pons.

ETIOLOGY AND PATHOLOGY.—Facial paralysis may be due to a lesion involving any part of the facial nerve-tract from the motor center in the lower Rolandic area of the cortex to the face muscles of the opposite side. If the lesion lies in the cortex or between cortex and facial nucleus in the pons, we have a “supranuclear” facial paralysis. If the lesion involves the nucleus in the pons, we have to deal with a “nuclear” paralysis. If the fibers of the nerve itself be affected, the term “infranuclear” is applied. A supranuclear or central paralysis is usually seen in association with a hemiplegia; the electrical reactions remain unaltered, the upper muscles of the face are but little involved, and voluntary movements are more impaired than is the power of emotional expression.

The peripheral form of Bell's palsy, or facial paralysis, that arising from lesions of the nerve-trunk or nerve-roots in the pons, is one of the most common of the peripheral paralyses. It is more often seen in early middle life, and in men than in women. The great majority of the cases have as their basis a neuritis of the facial nerve, due to exposure to cold. Such cases are sometimes referred to as “rheumatic.” Other causes are in-

jury to the nerve-fibers, as from accidental cutting during surgical operations upon the neck, or from blows, compression, temporal-bone disease, etc.

TREATMENT.—The pathological process underlying the paralysis, when such exists, should be first dealt with. In the common neuritic cases a **mercurial purge** should be given in the beginning, followed by **counterirritation** over the affected nerve-trunk, in the form of a **blister**, the **actual cautery**, or a strong **galvanic current**. The internal administration of **aspirin**, **salicylates**, or **salol**, continued for some days, is advisable. **Potassium iodide** is almost always beneficial, even in cases destitute of syphilitic taint. It should be given in moderate doses, continued for a long time. After subsidence of the acute symptoms **facial massage** and the local application of the **faradic current** in strength sufficient to produce muscular contraction will serve to hasten restoration of power to the paralyzed muscles.

LOCALIZED NEURITIS.

Disorders of the **glossopharyngeal**, or ninth pair of cranial, nerves are attended by perversions of the sense of taste, as well as by abnormalities of common sensation and motion in parts to which the nerve is distributed. The nerve may be affected alone, but is often involved, along with the hypoglossal, in the (nuclear) changes of bulbar paralysis.

The **pneumogastric** nerve, with its extensive distribution and varied functions, gives, when affected by disease, a many-sided clinical picture, the more prominent features being cardiac irregularities and gastric disorders. The nerve is rarely alone in-

involved, but not infrequently participates in the morbid changes of multiple neuritis, or beriberi. It may also be affected from injury, as a result of pressure from a tumor, etc. The tachycardia and acute gastric symptoms pertaining to disease of the pneumogastric nerve have already been referred to under multiple neuritis.

Some of the cases of "nervous" dyspepsia are attributable to disorder of the vagus. Some forms of paralysis of the larynx and pharynx, as well as some of the laryngeal neuroses, depend upon disorder of this nerve.

The **spinal accessory** nerve may be affected by a neuritis, rheumatic or other, or by injuries, tumors, etc. The result is paralysis or weakness of sternomastoid and trapezius muscles. Spasmodic wry-neck is sometimes traceable to spinal accessory disease.

The **hypoglossal** nerve is often involved as a part of a bulbar palsy, or in course of general paresis or other degenerative nervous disease. The prominent symptoms are paralysis and atrophy, with fibrillary tremor in the side of the tongue, with deviation of the tongue toward the sound side.

INFLAMMATION OF SPINAL NERVES.

The noteworthy diseases of the spinal nerves are the general conditions of neuritis, degeneration, etc., already described; the painful affections included under the term neuralgia (*vide infra*) and the affection known as sciatica, now to be dealt with.

SCIATICA.

This is to be regarded as a form of neuritis chiefly interstitial in character, the pathological changes being

located in the nerve-sheath. In severe cases the nerve-fibrils are also affected. The lesion is usually localized at the sciatic notch and near the middle of the thigh, and the pathological alterations shown are those of simple neuritis, previously sketched.

Practically every case of sciatica is caused by some lesion near the exit of the sciatic nerve. The pain and tenderness along the course of the nerve are simply referred pain from the low portion of the back. In order to properly treat sciatica, it is necessary to search for the cause of the trouble, which is either a mechanical pressure or inflammatory irritation at the origin of the nerve. Rogers (Boston Med. and Surg. Jour., Nov. 16, 1911).

The malady is most common in middle life, and is seen more frequently in men than in women. The remote or predisposing causes are general malnutrition; rheumatic, gouty, and uric acid diathesis; digestive defects, syphilis, and anything which lowers general vital tone. The exciting causes are exposure to cold, muscular overstrain, and direct injury, as from pressure or blows.

SYMPTOMS.—The characteristic symptoms of sciatic neuritis are pain and tenderness along the course of the sciatic nerve, with weakness and a sensation of stiffness in the muscles. The onset of the pain is usually gradual, it being felt at first only on exertion, but, as it becomes more severe, being constant. It is at times a dull ache; at others a sharp lancinating or acute burning pain. Formication, tingling, and some degree of anesthesia are common. In the later stages there is some atrophy of the calf and other muscles supplied by the sciatic nerve, and in a few in-

stances the disease extends to the lumbar plexus of nerves.

Trophic disorders, as edematous swelling and herpes, are of not infrequent occurrence.

The disease endures for weeks, months, or even years, although eventual recovery is the rule. Most cases last for months. The more acute and severe the initial symptoms, the longer the case will probably last. An obstinate form of neuralgia may persist after the other symptoms of sciatic neuritis are entirely gone. Secondary sciatic neuritis, from pressure of a tumor or a similar cause, can, of course, be relieved only after removal of the cause.

DIAGNOSIS.—As recently emphasized by Alexander, blunders in diagnosis are comparatively frequent. In neurasthenic pain there is a lack of objective symptoms; the pain is constant rather than paroxysmal; it fluctuates with the mood and with insomnia; the attention cannot be diverted from the pain, and the patient begins to groan when the foot is grasped for the Lasègue test. In true sciatica pain is not experienced until the leg is raised to an angle of 45 or 60 degrees. Spondylitis, sacroiliac disease or stretching of the symphysis in a wasting disease or pregnancy, and senile hip-joint disease frequently develop sciatic pain as the first symptom, but the insidious course, the röntgenoscopic findings, and the pain in the hip-joint when the flexed leg is passively moved differentiate the affection. In tabes the pain is generally bilateral and independent of active or passive movements; instead of the Lasègue sign, there is hypotonicity without pains. The writer has never encountered

sciatica in a tabetic nor a case of sciatica traceable to flat-foot alone. The sacral form of multiple sclerosis is hard to distinguish from true sciatica.

New symptom which was lacking in only 6 of his 124 patients with sciatica. It is an extremely painful point found by pressing the finger into the abdomen over the spinous process of the last lumbar vertebra, thus pressing on the nerve-roots and the sacral plexus. Gara (Deut. med. Woch., Apr. 20, 1911).

Several patients who came to the writers complaining of obstinate and long-standing sciatica. The source of trouble was found to be located at the lower extremity of the cecum. The latter, moreover, failed to rise when examined with the X-rays while the patient was in the Trendelenburg position. The authors therefore had 3 patients with particularly sharp pains in the lower limbs operated. In all, adhesions were found uniting firmly the cecoappendicular structures, themselves situated low down, with the posterior parietes. After appendectomy and liberation of the adhesions the patients were cured of their sciatica. Enriquez and Gutmann (Bull. méd., June 28, 1913).

A pathognomonic sign would prove of great value in cases where rapid and certain diagnosis is necessary. Such a sign is afforded by an increase of the abdominal reflex on the affected side while the reflexes are less pronounced or absent on the sound side. The superior, median, and inferior reflexes should all be tested. The patient lies on his back with his abdominal walls fully relaxed, and the limbs extended symmetrically. The sign is found in over 80 per cent. of all patients examined. Its presence in non-sciatic cases means some condition which could not be confounded with sciatica. Pisani (Malpighi, July 1, 1915),

To obtain the gluteus sign the writer, with the patient prone, taps on

the point of attachment of the gluteus maximus on a level with the second, third and fourth parts of the sacrum. This muscle then contracts; in exaggerated fashion in true sciatica. F. Rosa (Presse méd., June 4, 1917).

Flexion of the big toe on percussion of the tendo Achilles, in disorders of the sciatic nerve, may occur as sole symptom and can thus settle a doubtful diagnosis. Villaret and Faure-Beaulieu (Presse méd., Sept. 13, 1917).

TREATMENT.—In the treatment of sciatica the first requisite is absolute and complete rest of the limbs, all movements which give the least pain being scrupulously avoided. Simply confining the patient to bed may answer in many cases, but in the aggravated forms placing the limbs in splints is advised.

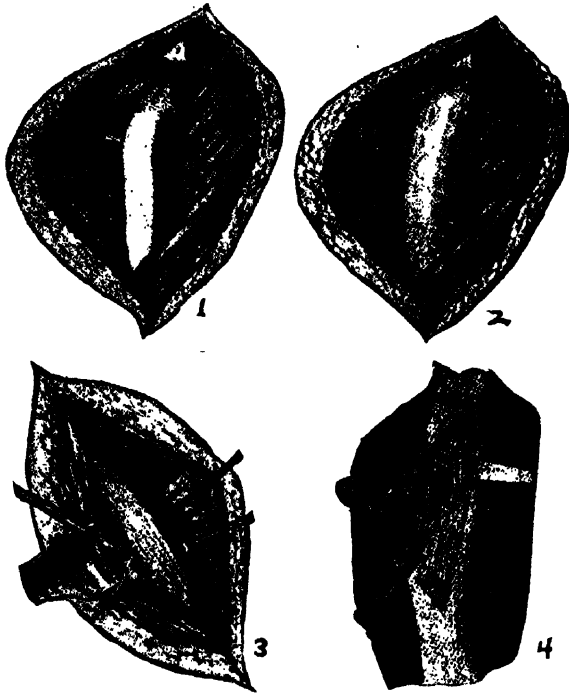
Hot applications, as hot poultices, superheated air, etc., are grateful in relieving the pain, while occasionally ice is more useful. Counterirritation by the actual cautery gives great relief sometimes. A strong galvanic current is always of service. The local hypodermic administration of drugs is preferable to the use of drugs by the mouth.

The writer used intravenous injections of phenol (Baccelli's method), 1:1000 solution, in the treatment of sciatica in 11 cases. The sciatica was of several years' standing in some of the cases and had completely incapacitated the patient. From 10 to 60 injections were required. Rosi (Policlinico, Oct. 13, 1912).

Marked improvement in 2 cases after a few daily subcutaneous injections of 1 c.c. (16 minims) of 1:1000 epinephrin solution. Gaisböck (Med. Klinik, Mar. 16, 1913).

Eight cases were treated by injections of 4 per cent. quinine and urea hydrochloride in salt solution into subcutaneous tissue over the course of the nerve. Fifty injections were

given in all, without untoward results. Always decided relief was obtained after 1 injection, and no further attacks occurred after the third. Injections were given daily for 4 doses, then every other day, until patient entirely relieved. Two cases of facial neuralgia were also treated, with complete relief after the second injection. Cables (Jour. Amer. Med. Assoc., Dec. 27, 1913).



1, sciatic nerve as it emerges from the sacrosclatic foramen unmodified; 2, sciatic nerve after intraneural injection of salt solution; 3, sciatic nerve after stripping off the perineurium, without adhesions; 4, sciatic nerve with adhesions extending to the perineurium. (Heile.)

(Berliner klinische Wochenschrift.)

Cold water injected into the muscles gives great relief. Acupuncture is frequently of great value. Where local remedies fail the internal administration of coal-tar products or morphine may be necessary.

Surgical measures, such as nerve stretching, splitting the sheath, etc., may be tried as a last resort.

The writer pulls on the leg of the reclining patient, exerting about as

much force as for pulling off a boot. If this relieves the pain of the sciatica, he applies extension systematically, raising the extended leg once or twice a day to the point borne without special pain and then applying extension to the foot with the leg resting on an inclined plane. This is repeated cautiously once or twice a day for from five to thirty seconds at a time. This stretching is supplemented by stretching the leg backward for a few seconds as the patient lies on the side. The ordinary measures are also applied, but the nerve stretching often proves successful alone. Heermann (Deut. med. Woch., Aug. 18, 1910).

Where, after relief through rest in bed, pain recurs upon movements of the thigh, the nerve should be exposed and examined for adhesions. Very small adhesions may be removed by nerve stretching, but, where large and numerous adhesions present, careful dissection with the knife necessary, and offers great chance of permanent improvement. Lewis and Taylor (Therap. Gaz., June, 1913).

The writer has found acute sciatica, especially sciatica developing after an accident, much easier to cure than moderate sciatica in patients with a familial tendency to rheumatism. When severe sciatica persists unmodified by persevering internal treatment, he injects 100 to 200 c.c. salt solution directly into the nerve. This loosens up the fibers and may break up adhesions that have formed between the fibers and the sheath of the nerve. He makes the injection just as the nerve emerges from the sacrosclatic foramen, at the center of a line drawn from the superoposterior spine to the tuberosity of the ischium. In 4 exceptionally severe cases of years' standing in which no measures had given but transient relief he cured the sciatica at one stroke by the following operation: He exposed the nerve where it pierced the pelvis, opened the outer sheath, and separated a net-

work of adhesions inside. He ran his finger into the foramen to learn if there was any pressure on the nerve beyond and found it necessary in 1 case to excise the arteria comitans or the pyriform muscles, as they seemed to press on the nerve. He concluded by injecting salt solution into the nerve beyond the point he could reach. The nerve thus carefully isolated was buried between the fibers of the gluteal muscle, drawn apart for the purpose. The results in these desperately chronic and agonizing cases were surprising. Heile (Berl. klin. Woch., Mar. 30, 1914).

The diet should be liberal and the general bodily state improved as much as possible by **tonics and hygienic measures**.

Nourishing diet, with fats predominating, advised. Milk, cream, eggs, butter, marrow, bacon, and oils to be given, with frequent feeding between meals, but meats to be eaten sparingly. Half an hour before each meal, give large cup of hot water containing a **glycerophosphate**. Hunt (Med. Record, June 28, 1913).

In the later stages of the malady **electricity and massage** should be used systematically, as they shorten the period of convalescence.

The writer has obtained excellent results from the use of **static electricity** in the treatment of chronic sciatica and similar forms of neuritis. He uses the Morton wave current, the brush, and indirect sparks. Webb (Lancet, Jan. 12, 1907).

Application of **dry cupping glasses** which the patients themselves can use, so that they may be frequently repeated. The writer has seen good results in acute cases from **wet packs on the hip and leg** and made with linen or silk bandages, wrung out in water of 60° to 70° and covered with a double layer of flannel. **Very light friction**, carefully applied by the physician himself, avoiding the most

painful spots, is sometimes very useful. Orb (Med. Press and Circ., Mar. 30, 1910).

Injectations of **saline solution** into the sciatic nerve have given good results in a large proportion of cases. The solution is given either pure or with an anesthetic.

Saline injections into the sciatic nerve were employed in 8 cases, 4 of which were cured, 1 after slight improvement made worse, and 3 lost sight of. Injections were made at sciatic foramen or gluteal fold, according as pressure causes greater pain at one or other. Hay (Glasgow Med. Jour., Apr., 1911).

The writer injects physiological **salt solution** containing one per mille **betacaine**, in quantities of from 70 to 100 c.c. (2½ to 3½ fluidounces) into the sciatic nerve at its point of exit from the foramen, using considerable pressure. A sudden jerk of the leg muscles follows when the point of the needle has pierced the nerve sheath. A. Lange (Pract., Jan., 1912).

Injectations of sterile normal **saline solution** near sciatic nerve were employed in 25 patients with following results: 13 cured; 10 improved, most of them being enabled to resume their former occupations; 2 unimproved. Leszynsky (Med. Record, Feb. 17, 1912).

Where acute attack, in spite of the usual measures, persists longer than ten to fourteen days, **sulphur baths** or **hot carbon dioxide baths** (102.7° to 104° F., and lasting twenty minutes) should be employed, or heat applied in other ways. If ineffective, the author counsels treatment by injections of **saline solution** and air: 1. Injection of 800 to 1000 c.c. of air, filtered through cotton, under skin on outer aspect of leg. 2. Injection of 60 to 80 c.c. (2 to 2½ fluidounces) of 0.8 per cent. **salt solution**, with 0.01 to 0.02 Gm. (⅓ to ½ grain) of **novocaine** added, just below sacrosiatic notch, as close to

nerve as possible. 3. Injection of 10 to 20 c.c. ($2\frac{1}{2}$ to 5 fluidrams) of **salt solution**, with 0.01 Gm. ($\frac{1}{8}$ grain) of **novocaine** into epidural space of inferior lumbar region, needle being passed in and up through coccygeal notch; preliminary anesthesia of course of injection with novocaine. 4. Where very severe pain and contractions of lumbar muscles, injection of 10 to 15 c.c. ($2\frac{1}{2}$ to $3\frac{3}{4}$ fluidrams) of salt solution between third and fourth lumbar vertebræ into epidural space. Injections to be repeated at intervals of three or four days, substituting 1 to 1.2 per cent. for 0.8 per cent. saline. Two to 5 series of injections cure obstinate cases. Sicard (*Revue de therap. med. chir.*, Jan. 15, 1912).

Perineural injections have been recommended by Cathelin and Sicard and **epidural injections** by Blum: **saline solution** with or without an anesthetic, a 0.25 per cent. solution of **cocaine** for instance.

Epidural injections of saline solution or an anesthetic to anesthetize the sacral nerve-roots after they have left the cord was discovered simultaneously by Cathelin and Sicard. The writer found that epidural injections were efficacious when the perineural injections failed. He injects from 5 to 10 c.c. ($1\frac{1}{4}$ to $2\frac{1}{2}$ fluidrams) into the spinal canal through the lower median sacral foramen, the needle piercing only the sacrococcygeal ligament. The epidural method is not painful and has never caused fever or other untoward effects, but injections by the perineural method have produced paralysis of the peroneus. Epidural injections affect a wider nerve distribution than do perineural injections. Blum (*Münch. med. Woch.*, Bd. lvii, S. 1681, 1910).

Prompt and permanent cure of sciatica was obtained by the writer with **epidural injections** of about 20 c.c. ($\frac{2}{3}$ fluidounce) of physiological **salt solution** or a weak anesthetic. His best results were obtained with

this amount of Schleich's No. II solution. This proved effectual in 5 of 7 cases of inveterate sciatica, as also in a case of tedious and rebellious coccygodynia resulting from a fall in a girl of 12. In this latter case the pain was banished permanently by a single injection of 10 c.c. ($2\frac{1}{2}$ fluidrams) of a 0.25 per cent. solution of **cocaine**. Glimm (*Münch. med. Woch.*, Feb. 21, 1911).

Twelve cases of sciatica treated with a 1 per cent. **novocaine-bicarbonate solution** with excellent results in some cases, in 1 patient the improvement lasting two years. Where brilliant results were not obtained the affection was probably not a true sciatica. Sciatica of the roots is the kind most amenable to this treatment. Læwen (*Deut. med. Woch.*, Jan. 2, 1913).

Reports of 12 cases of sciatica treated with **epidural injections of novocaine**. Seven of these patients were permanently cured. One cg. ($\frac{1}{8}$ grain) of novocaine, 0.25 Gm. (4 grains) of **sodium bicarbonate**, and 0.5 Gm. ($7\frac{1}{2}$ grains) of **sodium chloride** are dissolved in 100 c.c. ($3\frac{1}{2}$ fluidounces) of cold distilled water. This mixture is injected into the sacral notch between the tubercles. In fifteen or twenty minutes after the injections all symptoms of the sciatica disappeared, but he left the patients in bed for a few days. Langbein (*Deut. med. Woch.*, Bd. xxxix, 20, 1913).

According to Jassanetzky-Woino (*Zentralb. für Chirurgie*, xxxix, 1021, 1912), complete anesthesia of the sciatic nerve can be brought about by means of a 2 per cent. **novocaine-adrenalin solution**, 10 minims being injected. The point where the nerve can be easily and safely injected corresponds to the junction of a horizontal line passing through the top of the great trochanter and a vertical line through the margin of the tuberosity of the ischium. In 3 out of 20

cadavers the horizontal line was from 1 to 1.5 cm. too high. In all the others the junction of these two lines was exactly at the point where the nerve, immediately after making its exit from the great sciatic foramen, lies directly on the bone.

The most satisfactory method of treatment comprises **absolute rest** in bed, the application of **warmth** along the course of the nerve and specially in the gluteal region, and the administration of large doses of the **salicylates** during the early stages. If the attack does not respond, the writer injects 100 to 150 c.c. ($3\frac{1}{2}$ to 5 ounces) of **saline solution** into the region of the sciatic nerve at a point 1 inch to the outer side of the junction of the inner third with the outer two-thirds of a line drawn between the sacrococcygeal articulation and the lowest point of the posteroexternal border of the great trochanter. From 3 to 5 such injections may be required at intervals of 2 days before there is permanent relief. The second method is the injection of 60 to 80 c.c. (2 to $2\frac{2}{3}$ ounces) of **warm sterile saline solution** into the epidural space through the superior sacral foramen. The first 10 to 20 c.c. ($2\frac{1}{2}$ to 5 drams) of the saline should contain a small amount of **adrenalin** and 125 mg. (2 grains) of **novocaine**. I. Strauss (Jour. Amer. Med. Assoc., Dec. 15, 1917).

The **X-rays** and **autogenous vaccines** have been tried with some degree of success.

The writer made a **vaccine** from a throat coccus, and at once gave the patient a dose of 100 million, killed by one hour at 60° C. In a week the writer doubled the dose. This increased the pain and developed 0.5° F. temperature elevation, which disappeared within twenty-four hours. Three days later he was up and about, greatly improved, and at the end of the week was given the third dose, 400 million. This reacted about as the preceding, but when he returned again, seven days later, all

pain had disappeared, and a final precautionary dose of double the last was given without any following reaction, and the patient has been without the least symptom of the malady for the past five months. Greeley (N. Y. State Jour. of Med., Apr., 1914).

NEURALGIA.

DEFINITION AND VARIETIES.—Neuralgia is a functional or mild neurotic disorder of the sensory nerves or their centers, characterized, as the name indicates, by pain. The affection may be idiopathic—depending upon some functional disturbance alone, or it may be symptomatic—due to some organic disease of the nerve or to some disease or pathological state outside of the nervous system, such as neuritis, anemia, and toxemia. The tendency of later years is to diminish the number of idiopathic neuralgias by the discovery of organic disease with demonstrable pathological changes in the nerve-trunks.

Neuralgias are classified, according to their causes, as “neuritic,” “toxic,” “gouty,” “rheumatic,” etc.; or according to their location, as “trigeminal,” “sciatic,” “intercostal,” “cervico-occipital,” etc. The general features of the disorder will be first discussed, and after these the more important clinical varieties will be briefly described.

SYMPTOMS.—Pain is the chief and characteristic symptom, the onset of the pain being sometimes preceded by soreness and stiffness in muscles and tissues of affected part, sometimes developing suddenly and without warning. The pain is intermittent or paroxysmal, of a darting, stabbing character, accompanied sometimes by burning and tingling

sensations. There is usually tenderness over the entire nerve-trunk, with certain "painful points" at which the tenderness and pain is greatest. The paroxysms of pain may occur only at long intervals, but usually, for some hours, they occur every few minutes; in aggravated cases may be nearly continuous for hours or days. In occasional cases there may be some pain continuously for months or even several years. In some instances the pain is greatest at a certain time each day, the seeming periodicity being most marked in malarial cases, although seen where there can be no thought of malarial influence.

Trophic and vasomotor disturbances in affected area, such as coldness, eruptions, falling out or changes in color of the hair, etc., are occasionally seen. In some forms of neuralgia twitching or spasm of adjacent muscles accompanies the paroxysms.

DIAGNOSIS.—The diagnosis of neuralgia is simple, the presence of the characteristic pain being sufficient. The only practical difficulty is in distinguishing between neuralgia and neuritis, and here, since the conditions shade into one another, it may be impossible to draw a sharp dividing line. Generally speaking, the pain in neuritis is more constant in location than is the pain of neuralgia; it does not shift nor dart from one nerve to another; there is in neuritis much more muscular weakness, stiffness on movement, and relaxation of tissues, and absence of the history of repeated attacks.

In the diagnosis of neuralgia a radiograph of the parts should be taken when severe persistent neu-

ralgia exists so as to exclude the possibility of the pain being due to an inverted third molar, whose crown, by pressing on the nerve passing through the inferior dental canal, not infrequently causes neuralgic pains. J. W. Brophy (Treatment, Dec., 1905).

Diagnosis between myalgia and neuralgia. In myalgia tenderness of one or more muscles in the painful region, hyperalgesia of the skin over these tender muscles; an injection of a small quantity of sterile salt solution into a muscle proves painful if the muscle is inflamed, but not painful if it is not inflamed; frequently patients who have myalgia complain of paresthetic symptoms, rather frequently the affected muscles show a weakness in their action, the character of the pain is different from that of neuralgia, and the topography is different. Peritz (Berl. klin. Woch., July 29, 1907).

Neuralgia and soreness in the neck in the region of the tonsils usually arise from diseased tonsils. Neuralgias in the region of the tonsil, ear, side of head, neck, nose, teeth, gums, or antrum of Highmore may be and frequently are caused by diseased tonsils. Disturbances of function through pressure on or inflammation of nerves may manifest itself in hoarseness, in loss of voice, cough, difficult deglutition, or entrance of food into trachea, with regurgitation, or in defects in hearing, dyspepsia, and disturbed heart action. Such diseased tonsils may not be and usually are not large or acutely inflamed. F. C. Todd (Jour. Amer. Med. Assoc., Aug. 27, 1910).

Acute and chronic rheumatism of the vertebræ, tuberculous processes in the bronchial lymph-nodes, and disturbances in the spine of the same nature as those in the foot from flat-foot,—these three affections may induce sharp pains, actual spinalgia, simulating various other troubles and liable to be misinterpreted and mis-treated. The pain and hyperesthesia

with these affections are always bilateral. The patient may not be aware of this bilateral character,—usually not,—but it can be determined by delimiting the area with the needle and studying the character of the pain, which is always typical of true neuralgias. The zones of hyperesthesia are abnormally sensitive to contact, to pressure, and to temperature. The “pressure points” are also excessively tender. Zuelzer (Berl. klin. Woch., Sept. 8, 1913).

ETIOLOGY.—Neuralgia is a disease of middle life, rarely affecting children and rarely occurring in old age. It is somewhat more frequent in women than in men; more frequent in cold than in warm weather; more frequent in cold and damp climates than in dry and warm localities.

Members of neuropathic families are more liable to the disease than are persons of good nervous heredity. The immediate exciting causes are anything which lowers general nerve tone and any toxic agent or disease attended by toxemia, such as anemia and general cachectic states, malaria, infectious diseases, autogenous poisonings, diabetes, lead poisoning, etc.

Report of 53 cases of neuralgia due to excessive smoking. There were 31 cases of sciatica and 22 of brachial neuralgia. Diffuse pains, not restricted to individual nerve areas, were represented by 110 cases. The nature of these latter is obscure, as in some cases an arthropathy seemed to be present. The condition termed by Erb *dyskinesia intermittens angiosclerotica* is abundantly recognized by its sponsor as occurring much more frequently in heavy smokers than in any other class of people. It is very largely a tobacco angioneurosis. Von Frankl-Hochwart (Deut. med. Woch., Dec. 14, 1911).

Exposure to cold may precipitate attacks in those predisposed, as may reflex irritations from disease of eyes, ovaries, abdominal organs, carious teeth, etc.

Case in which the patient complained bitterly of pain back of the eye, the vision of which was slightly affected and the visual field somewhat contracted. The papilla was rather congested. Examination revealed a gold-capped tooth, the left upper second molar, which was sensitive and had been recapped several times by different dentists during the past year. Extraction of the tooth was advised and performed, when a dental spud was found extruding from its posterior root about $\frac{1}{8}$ inch. The pain back of the eye was completely relieved, the vision improved to normal, the blurring disappeared, and the visual field was nearly normal two days after the extraction of the tooth. H. V. Wuerdemann (Ophth. Record, Nov., 1913).

Where hereditary predisposition is very strong the affection may develop without discoverable cause. The neurasthenic and hysterical are particularly prone to suffer from neuralgia.

In many cases of neuralgia, the true “functional” or idiopathic cases, no pathological alterations in the nerve-fibers, cells, or ganglia can be detected, the presumption being that the pain is due to malnutrition or toxemias of a degree too slight to cause alterations of structure. In other cases the nerve-trunks are swelled and tender, and in most such cases the pathologicoanatomical changes are those of a mild interstitial neuritis.

TREATMENT.—The first indication is **removal of the cause**, when such is discoverable and can be removed. General tonic and hygienic

treatment is always advisable, as any improvement in vital tone and blood quality gives measurable relief from idiopathic neuralgia. Removal from an unhealthy climate often gives relief. Iron, arsenic, strychnine, cod-liver oil, and phosphorus, singly or in combination, are the tonics most used. Quinine, at one time much lauded as a specific for some forms of neuralgia, is apt to prove disappointing.

Case of trifacial neuralgia of fourteen years' standing which had resisted all the usual remedial means, including resection of the sensory root of the nerve and the injection of cocaine, and in which subcutaneous injections of quinine and urea hydrochloride brought apparently permanent relief. H. Crenshaw (Therap. Gaz., Dec., 1912).

Records of 5 cases of trifacial neuralgia (1 case being multiple neuritis plus trifacial neuralgia) in which the treatment consisted of strychnine exhibited in large doses. All of these cases were due to infection, which seems to be the important indication for the exhibition of strychnine. The strychnine treatment was given by mouth or hypodermically in $\frac{1}{40}$ - to $\frac{1}{30}$ - grain (0.0016 to 0.0022 Gm.) doses hourly for four hours morning and evening. Orbison (Calif. State Jour. of Med., Oct., 1913).

Local applications are sometimes helpful in the milder forms.

For the local treatment of neuralgia, the following liniment is recommended:—

℞ *Chloroformi* f℥ss (15 c.c.).
Ætheris f℥iss (45 c.c.).
Alcoholis f℥iv (125 c.c.).
Camphoræ ʒij (8 Gm.).
Tincturæ opii ℥L (3 c.c.).

M. et ft. linimentum.

A square piece of flannel should be moistened with the liniment, placed

over the seat of pain, and covered with some impermeable material.

In pains at the anus not accounted for by a fistula or rectal lesion the following liniment may be rubbed over the part several times a day:—

℞ *Extracti belladonnæ*
foliorum ʒss (2 Gm.).
Chloroformi f℥ss (2 c.c.).
Glycerini f℥ss (15 c.c.).

M. et ft. linimentum.

In periorbital neuralgia and ophthalmic migraine the writer uses the following ointment:—

℞ *Mentholis* gr. xiiij (0.85 Gm.).
Cocainæ gr. iv (0.25 Gm.).
Chlorali hydrati. gr. iiss (0.15 Gm.).
Petrolati gr. lxxv (5 Gm.).

M. et ft. unguentum.

Sig.: Rub ointment over the seat of pain and cover with oiled silk.

Galezowski (Paris médical, May 31, 1913; N. Y. Med Jour., Dec. 6, 1913).

The systematic use of electricity, long continued, is one of the most valuable means at our disposal for the permanent relief of neuralgic pain, the galvanic current giving best results. The use of X-rays has recently been lauded.

The writer reports the successful result of the use of the high-frequency currents in a case of very resistant trigeminal neuralgia which had not been improved by any other form of treatment. W. F. Somerville (Brit. Med. Jour., Dec. 21, 1912).

Application of X-rays to corresponding nerve-roots gives good results in brachial or trigeminal neuralgia or neuritis, provided the condition be due to a true radiculitis or a lesion compressing the nerve-roots, and not to peripheral involvement. Zimmern, Cottenot, and Dari-aux (Presse méd., June 25, 1913).

Of remedies for the relief of the paroxysms of pain the coal-tar derivatives stand first. Gelsemium also is a valuable antineuralgic agent, as

are **ether**, **valerian** (these last two often in combination); **aconite** or its active principle, **aconitine**; **cannabis Indica**, and **cimicifuga**. **Alcohol** given internally oftentimes affords relief, but it is a dangerous remedy and should be prescribed with caution. **Nitroglycerin** has been found useful in cases of facial neuralgia.

If 5 to 10 drops of **guaiacol** are gently rubbed into the skin over the painful spot, the neuralgic pain will cease at once, no matter of what character the neuralgia may be. A. Brodnax (Wisconsin Med. Recorder, p. 228, 1900).

One-fourth, $\frac{1}{8}$, or even $\frac{1}{10}$ grain (0.015, 0.008, or 0.006 Gm.) of Merck's medicinal **methylene blue**, in watery solution, hypodermically near the seat of pain or near the spinal source of the affected nerve is generally sufficient. Using these small doses, two points of, injection may sometimes be advisable at the same sitting. A. de Voe (Medical World, Sept., 1902).

Chloroform is the nearest approach to a specific in the treatment of neuralgia. The method is devoid of any untoward effects, both immediate and remote. Chloroform injected locally has no systemic effects, but a local anesthetic effect. Superficial injections often act with certainty, even when the pain seems to be deep seated. S. Ormond Goldan (N. Y. Med. Jour., June 13, 1908).

The writer has obtained good results in 16 cases of exceptionally severe trigeminal neuralgia and also in 100 moderate cases by treatment with **aconitine** and **vigorous purgation**. The aconitine seems to have actual specific efficacy in trigeminal neuralgia. He prefers to give it in the form of 8 or 10 pills containing a maximum of 0.002 Gm. ($\frac{1}{32}$ grain) for the daily dose. It is supplemented with **calomel**, 15 grains (1 Gm.) in 10 doses in ten hours (0.1 Gm.— $1\frac{1}{2}$ grains—per dose), continu-

ing afterward with a laxative water three times a day. In giving the aconitine he inquires constantly for signs of intoxication, paresthesia in tongue, lips, or hands, mostly in the ulnar region, but has never observed anything of the kind, probably on account of the vigorous purgation which he regards as the greatest advance in the treatment of neuralgia in the last quarter-century. Fuchs (Med. Klinik, July 18, 1909).

Since preparations of **aconitine** have become reliable, this agent can be advantageously employed in neuralgias of the fifth pair, especially when all other antineuralgics, such as morphine, quinine, antipyrin, pyramidon, phenacetin, etc., fail. It is given in doses of $\frac{1}{20}$ mg. every two or three hours until the desired effect is obtained—1 mg. ($\frac{1}{65}$ grain) within twenty-four hours never to be exceeded. In facial and secondary neuralgias aconitine acts as a specific in allaying the pain; at the same time the removal of the causative factor must not be overlooked. During the dosing, the patient must be watched for dryness of the mouth, tickling sensation in the extremities, —a very characteristic phenomenon, —and paresthesia of the lips and tongue, these symptoms indicating diminution in dosage or extension of the intervals of administration. H. Versluysen (Revue trimes. belge de stomat., June, 1910).

Case of severe trifacial neuralgia in which, all ordinary measures finally proving unavailing, 2 injections of the following solution were made into the infraorbital canal on two successive days:—

\mathcal{R} *Sodii salicylatis*. gr. viiss (0.5 Gm.).
Cocainæ hydro-
chloridi gr. $i\frac{1}{4}$ (0.075 Gm.).
Aquæ destillatæ f3iiss (10 c.c.).

M. et ft. solutio.

The injections were administered slowly with a 2-c.c. ($\frac{1}{2}$ fluidram) syringe, under local anesthesia of the skin with **ethyl chloride**, the infraorbital foramen having first been

located at the junction of the inner third and outer two-thirds of the lower margin of the orbit, 5 mm. below a slight bony elevation palpable with the finger. Almost complete relief from pain was at once obtained, and at the time of writing this result had been maintained for six months. Monestié (*Jour. des sciences méd. de Lille; N. Y. Med. Jour.*, Apr. 26, 1913).

When all other remedies fail, **morphine** hypodermically may justifiably be used, but there is great danger in these cases of initiating the habit, and other measures should be employed if at all possible.

In a case of neuralgia of the brachial plexus which resisted hot-air baths, electricity, electric light baths, and antineuralgics, 20 c.c. ($\frac{2}{3}$ fluid-ounce) of 2 per cent. **novocaine** solution were injected above the clavicle, after the method of Kuhlenkampff. The pain, as well as the tenderness on pressure, were at once relieved, also the swelling. Two weeks later the patient returned to his work. M. Thobben (*Münch. med. Woch.*, Aug. 26, 1913).

Case of severe neuralgia of the right ophthalmic nerve, of 5 years' standing, in a man of 37, in which **ionization** with a 3 per cent. **sodium salicylate** solution brought lasting relief after 3 sittings at 3-day intervals. The positive electrode was a towel dipped in distilled water and placed over the back of the neck. The positive or active electrode was placed over the pharyngomaxillary region. The current was increased at successive sittings from 20 to 40 and then to 70 milliamperes, and the duration of treatment from 20 to 35 and lastly to 50 minutes. Jouin (*Journal de médecine de Paris*, Dec., 1919).

Acupuncture, injection of water or saline solution beneath the skin, and active counterirritation may also be used with some hope of benefit.

Series of cases of severe neuralgia in which **castor oil** brought about a speedy cure. It should be given in doses of from 1 to 2 fluidounces (30 to 60 c.c.) three or four times daily, although in some cases good results have been obtained with smaller doses. After the first two or three doses it usually loses its cathartic effects. We should guard against its too free cathartic action by sufficient doses of opium in some form, as it is the constitutional, and not the local, effect that it is desired to produce. It is best given (after having been thoroughly washed and a few drops of some aromatic essence added) either in milk with effervescing Seltzer water or in ale, especially Bass's ale. A palatable mixture can be made by combining the oil with mucilage of acacia and lime water. It should be thoroughly shaken before given. It may also be given in hot lemonade. The writer extols this simple remedy, which has given results in neuralgia never obtained by other methods. F. W. Waxham (*Medical Record*, April 12, 1902).

Hydroquinone in doses of 1 to 4 Gm. (15 to 60 grains) daily in these disorders proved valuable for the removal of pain in cases in which other analgesics had been used in vain. No untoward after-effects were noticed. In articular rheumatism, however, the drug proved useless. E. Meyer (*Berl. klin. Woch.*, February 8, 1904).

Report of 17 cases of neuralgia, mostly old inveterate sciatica, in which a cure was obtained by subcutaneous injection of **oxygen**. All but 1 of the patients were men between 25 and 75, and 11 had had simple primary sciatica for from one to twelve months, the pain being so severe that none was able to work. All had the usual painful points and Lasègue's sign, that is, pain when the leg, held stiff, was raised horizontally and subsidence of the pain when the thigh was flexed on the pelvis with the knee flexed. These

patients were all cured in the course of fifteen days with from 6 to 10 applications of the oxygen, injecting each time about 300 c.c. (10 fluid-ounces). The oxygen abolishes the pain completely, while improving the nutrition of the parts and the general metabolism. Its application is simple and inexpensive. Sicuriani (Gaz. degli Ospedali, Mar. 29, 1908).

Chronic neuralgia is due to a purely physical cause, viz.: increased blood-pressure, and all the remedies which relieve neuralgia act either as the anodynes do, by benumbing the sensory filaments of the nerve or diminishing the force of the circulation, or by aiding the blood-vessels to resist the pressure on them. In addition to the usual remedies the writer has given **ergot** in full doses and on theoretical grounds with excellent results. It is especially useful in the chronic neuralgia of overfed women in the higher walks of life, who take little or no exercise. A fluidram (4 c.c.) three times a day, with **forced exercise** and **diminished food supply**, is very efficient. Reyburn (Wash. Med. Annals, Nov., 1908).

The writer has been using for some time physiological **salt solution**, just below freezing point, for local treatment of neuralgia. The advantages of the chilled solution are the immediate abolition of the pain, which has a most encouraging effect on the patient, freeing him at one stroke from his long torture. Acute sciatica in all cases, and the chronic form in the majority of cases, are not suited for this injection therapy. Schlesinger (Med. Klinik, Dec. 6, 1908).

In severe and obstinate cases the question of surgical interference may arise, the usual resources being **nerve stretching** and **excision** of a portion of the **nerve-trunk** or of its **ganglion**. These procedures always give temporary relief or respite from pain for some months, but unless there has been total destruction of the affected

sensory neurons, as by removal of the **Gasserian ganglion**, the pain is liable to return as the nerve-fibers regenerate. This is referred to under the next heading, the form for which operative procedures are usually necessary.

In even quite severe cases the pains are liable to spontaneously subside in old age, or frequently after the climacteric in women.

NEURALGIA OF SPECIAL BRANCHES.

Neuralgia of the Fifth Pair—Tic Douloureux.—Neuralgia of the fifth pair of cranial nerves is also known as trifacial neuralgia, facial neuralgia, etc., and also *tic douloureux* when the pain is extremely severe and attends spasm of the facial muscles.

Neuralgia of the fifth pair is more frequent than all other forms of neuralgia combined, and is, from a clinical standpoint, the most important of the forms of neuralgia with which the physician has to deal, this nerve seeming peculiarly susceptible to functional and organic disorders as a consequence of the complexity and highly differentiated character of its structure and connections.

All three of the branches are seldom affected simultaneously. The ophthalmic branch is that most often involved, giving rise to neuralgic pain in eye and brow ("brow ague") with an especially painful point at the supraorbital notch. In some cases the pain is especially intense in the eyeball. When the infraorbital branch is involved there is the usual pain in the area of distribution of the nerve, and a marked tender point at infra-orbital foramen. A toothache-like pain in upper teeth is common. In neuralgia of the inferior dental branch

the pain is often diffuse, extending from temporal region over the side of the face to the chin, with pain in lower teeth and side of the tongue, the last mentioned being, in some cases, the situation of greatest intensity.

Trigeminal neuralgia in younger persons, when the pain is restricted to one branch of the second or third branch of the trigeminus nerve, is suspiciously of a dental origin. The pains are more diffuse than in ordinary neuralgia; they do not seem to follow the track of the nerve, and vary in intensity without ever disappearing completely. Wallisch (Wiener klin. Woch., June 11, 1908).

In severe forms of pain involving any branch of the fifth nerve the pain may in lesser degree extend to the other branches. In all forms of facial neuralgia trophic disorders, in particular herpes, may occur. When the pain in facial neuralgia is very intense and markedly paroxysmal, with reflex facial muscular spasm accompanying, we have the form known as "tic douloureux": the most distressing and intractable form of nerve-pain. The general symptomatology and causation, as well as therapeutic indications, of neuralgia in general apply to the facial form.

Treatment.—In treatment of neuralgia of the fifth pair **improvement in general health** is first to be sought.

For the relief of the acute pain **opium**, of course, is most reliable, but it should not be employed until **aconite**, **coal-tar remedies**, and other analgesics have been given a trial. **Galvanic electricity** seems especially valuable. The **cataphoretic administration of cocaine**, **chloroform**, **aconite**, and other similar drugs gives in many cases complete and entire relief

for many hours. The continued hypodermic use of **strychnine** at the seat of the pain has given excellent results in preventing the return of the paroxysms. Dana recommends in tic douloureux injections of strychnine made once a day, the dose being gradually increased from $\frac{1}{30}$ to $\frac{1}{5}$ or $\frac{1}{4}$ grain; ten to twenty days are required to reach this maximum. As adjuvants to the injections **potassium iodide** and **iron**, **rest in bed**, **light diet**, and **diluents** are to be used. **X-rays** have also given good results.

Injections of **osmic acid** in 1 or 2 per cent. solution into the nerve-trunks relieve the pain at once, and in a large percentage of cases for a long time. The injections can be made with local or general anesthesia (general preferred by the author), and are free from danger. Judging theoretically from the experience with incisions, resections, and ganglion operations, the relief should not be permanent after the injection of the osmic acid. From clinical experience up to date, however, the fact is that many cases are permanently cured. J. B. Murphy (Jour. Amer. Med. Assoc., Oct. 8, 1904).

Marked benefit was obtained in cases of occipital, trigeminal, and lumbar neuralgia and in meralgia paresthetica from **radicular X-rays**. Excepting the cases of facial neuralgia, particularly those of the tic douloureux type, the results obtained were remarkably constant. They were especially rapid and complete in neuralgia of the brachial plexus. Only rather small doses of the rays need be used; 1 or 2 applications averaging three H units, with filtration through 2 or 3 millimeters of aluminum, proved sufficient to bring about complete cure or at least to allay the pain very greatly. Zimmern (Paris méd., Feb. 7, 1920).

The measures described under the preceding heading are as applicable

in the present form, but in severe cases more active interference is necessary: injections of a 70 to 90 per cent. alcohol.

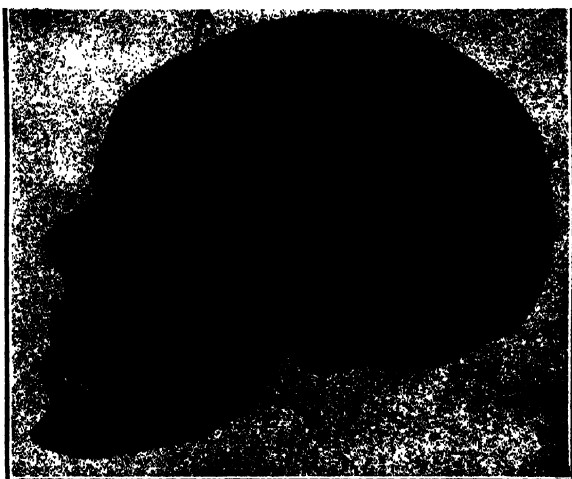
Schlosser uses a stout needle, 10 cm. long and 15 mm. in diameter. Within this is fitted a blunt stilette, the point of which projects slightly beyond the sharp end of the needle. The needle is marked off in centimeters up to 5 cm., so that we may know at what depth the point is. In making the injection through the skin (previously disinfected, and frozen by chloride of ethyl) the stilette is slightly withdrawn, so that the sharp point of the needle pierces the skin easily. Stewart (Brit. Med. Jour., Sept. 25, 1909).

The writer has treated 60 cases of trifacial neuralgia by deep injections of alcohol, 70 to 90 per cent., with success. A total of 180 injections was given, an average of $3\frac{1}{4}$ injections, to subdue pain. Thirty-seven patients were distinctly benefited; 11 were improved; 8 unimproved; 4 were aggravated. One patient was free from pain for a year and eight months; the shortest interval of freedom from pain was two weeks; several were free from pain for a year. If reinjected, pain was again subdued. Hecht (Med. Record, June 18, 1910).

In the severer forms 5 per cent. phenol in alcohol injected into the sphenopalatine ganglion to the amount approximately of 1 drop is painless and apparently curative for the various forms of neuralgia. In this method cocaine is first caused to soak into the ganglion from the mucous membrane covering the sphenopalatine foramen. A straight needle is then introduced from in front backward and upward under the posterior tip of the middle turbinate, a distance of 5 to 6 mm. G. Studer (Jour. Amer. Med. Assoc., Dec. 30, 1911).

The writer reports successful results in the relief of pain in about two-thirds of his 102 cases in which

deep injections of alcohol were used. Of 20 patients treated in this manner, five years ago, 9 are still free from pain. The diagnosis needs to be accurate, for there are neurasthenic conditions which bear close resemblance to trifacial neuralgia, and, if such cases are operated on, the resultant paresthesias become very irritating, and the condition of the patient is made worse. In trifacial neuralgia the paresthesias cause little if any discomfort, perhaps because the patient is less sensitive to minor



Landmarks for injections into foramen rotundum and foramen ovale. A, site of puncture for foramen rotundum. B, site of puncture for foramen ovale. (Stewart.)

(British Medical Journal.)

sensory disturbances than the normal individual. Shires (Can. Med. Assoc. Jour., Sept., 1912).

The ophthalmic nerve is not suitable for the injections, as there are other important vessels and nerves too near to permit them to be used with perfect safety. Superficial injections of the supraorbital nerve have been usually successful. It is usually easily located by pressure over the supraorbital notch, but if this cannot be found the operator must rely on his anatomical knowledge and the distribution of analgesia after the injection. The supra-trochlear branch of the frontal nerve may have to be separately injected.

It may be reached at a point about midway between the inner canthus of the eye and the eyebrow on a line running upward and inward at an angle of about 45 degrees. The solution used is **muriate of cocaine**, 2 grains (0.13 Gm.); **alcohol**, $2\frac{1}{2}$ fluidrams (10 c.c.), and distilled water a sufficient quantity to make $\frac{1}{2}$ fluid-ounce (15 c.c.).

The writer prefers not to use an anesthetic, as the sensations of the patient are of great assistance in locating the injections and showing its results in the production of anesthesia or analgesia in the distribution of the nerve. He likes to wait two or three days before repeating the injection, but has given a second in twenty-four hours, and even a third on the second day after. H. T. Patrick (*Jour. Amer. Med. Assoc.*, Jan. 20, 1912).

The writer recommends the use of $\frac{1}{8}$ grain (0.02 Gm.) of **morphine** and $\frac{1}{450}$ grain (0.0004 Gm.) of **hyoscine**, hypodermically, twenty minutes before the injection of **alcohol**. This dulls the sensation so as to prevent serious discomfort to the patient, but it still enables the operator to determine, by questioning, when he has penetrated the nerve. Wilfred Harris (*Lancet*, Mar. 29, 1913).

In over 400 cases of facial neuralgia treated by injection of **alcohol** in the past few years, the writer has not had a single failure, so far as the relief of the pain was concerned. He used 80 per cent. alcohol and injects from 1 to 2.5 c.c. (16 to 40 minims). It frees the patient entirely of his pain and anxiety. Recurrences are frequent, if not the rule, and in his experience he has seen only about 22 per cent. remain free from pain for longer than three years. In the rest of the cases recurrences have appeared in from eight months to two and one-quarter years. The procedure is painful, but the patients are all quite ready to endure a short pain for the prolonged relief to follow. O. Kiliani (*N. Y. State Jour. of Med.*, June, 1913).

The only effectual treatment of this disease is the destruction of the branches of the nerve, "local neurolysis," by chemical substances, particularly **alcohol**, varying in strength from 70 to 95 per cent. The writer injects not over 1.5 c.c. (24 minims), under local anesthesia by **novocaine** or **stovocaine**, into the nerve in the foramina where it can be reached. Some of these are superficial, the supraorbital and infraorbital; the opening of the inferior dental canal at the spine of Spix is deeper; the foramen ovale and foramen rotundum are deep. The writer prefers to make the deep injections 4 or 5 days after the others, but sometimes makes all 5 injections at the same sitting. Care must be taken not to inject the alcohol into a blood-vessel, as this may cause a gangrenous necrosis of the area supplied by the vessel. The results are said to be remarkable, though relapses are apt to take place in from twelve to eighteen months. Cutaneous or mucous anesthesia of the area innervated by the injected nerve is the only evidence that can be obtained of a successful injection. This should supervene directly after the injection, and is accompanied by a (false) sensation of induration and swelling. J. A. Sicard (*Boston Med. and Surg. Jour.*, Sept. 19, 1918).

Operative treatment procures the most lasting results, especially removal of the Gasserian ganglion.

There is an increasing tendency to abandon intervention on the Gasserian ganglion for surgery of the roots and, still more, for local injections of alcohol. Destruction of the root at the base of the brain seems to be the only means of preventing recurrence. Sicard (*Presse méd.*, Oct. 24, 1908).

Excision of the Gasserian ganglion is the only certain cure. If the case is very severe and all three branches are involved, the latter operation should be done without wasting time on the others. If not so severe, injections of **alcohol**, repeated at need,

may prove sufficient or resection at the base of the skull in case only two branches are involved. Hülles (Wiener klin. Woch., July 8, 1909).

Report of surgical treatment of trifacial neuralgia, including a series of 23 intracranial and 15 extracranial operations, with 1 death. The physician should no longer harbor the traditional dread and fear of **operation on the Gasserian ganglion**. Too often the operation is put off until the patient is addicted to the morphine habit and depleted in strength and vitality by drugs, sleepless nights, and years of intense suffering. The Gasserian ganglion is easily exposed; hemorrhage and shock need no longer be considered elements of danger; death from shock or from hemorrhage does not occur in experienced hands; the risks of operation are only those associated with any other major procedure. Recovery from the effects of the operation is rapid; the patients are frequently up and about on the third or fourth day; and the ultimate results are, to say the least, most gratifying both to patient and operator. C. H. Frazier (Univ. of Penna. Med. Bull., Apr., 1909).

Case of true tic douloureux of the sensory filaments of the facial nerve cured by **extirpation of the geniculate ganglion**. It has recently been proven that the facial nerve, like the trifacial, is a mixed nerve with its sensory root in the nerve of Wrisberg. Clark and Taylor (Jour. Amer. Med. Assoc., Dec. 25, 1910).

Trephining on the opposite side for the relief of facial neuralgia was devised by Jaboulay in 1908. Two more instances are now given. In both cases simple **trephining over the opposite Rolandic area**, with incision of the **dura mater**, was followed by complete success, permanent in the earlier case at any rate for two years. Even this result quite justifies the operation, which has the great merit of simplicity and safety. Chaliier (Gaz. des hôpitaux, No. 123, 1911).

In removal of **Gasserian ganglion** the writer found that, by the instillation into the eyes of **atropine** and irrigation with a solution of **boric acid**, neuroparalytic keratitis may be prevented. Relapses following the removal of the ganglion he explains by the assumption that either the extirpation was not complete or else the patient was at the time in the first stages of locomotor ataxia, the latter affecting the roots of the trifacial nerves. Pussep (Roussky Vrach, Mar. 10, 1912).

Report of a series of 156 **Gasserian ganglion operations** with 2 fatalities in the earlier cases. In 100 consecutive cases operated on there were 46 males and 54 females. The neuralgia affected the right side in 62 cases; the left in 36 cases. Both sides were involved in 2 cases. It is the impression that these neuralgias occur very much more commonly on the right side, but in his last 50 cases there had been an unusual number of left-sided neuralgias, which had brought the percentage up to 36, whereas previously the ratio between neuralgias of the right and left sides was about 3 to 1. Two of the patients operated on were 80 and 90 years of age, respectively. Harvey Cushing (N. Y. Med. Jour., Nov. 22, 1913).

Cervico-occipital neuralgia is located in first four pairs of spinal nerves, posterior branches, and is most often a result of exposure to cold or of disease of the adjacent vertebræ.

Cervicobrachial neuralgia involves the sensory nerve-fibers of the brachial plexus, its common causes being cold, rheumatic disorders, or local injury. The pain is situated in the shoulder, and may extend down the arm along the course of the ulnar nerve. According to Oppenheim, brachial neuralgia is a rare disease, and is frequently only a symptom of an organic or functional disorder of

the central nervous system or of genuine neuritis. It most often consists in pain in the arm of ill-defined character and localization of a pain of psychical or neurasthenic origin, rather than that of a genuine neuralgia.

Intercostal neuralgia, involving one or more of the intercostal nerves, is, after facial neuralgia, the most frequent and important form. It is seen more often in women than in men, giving rise, when located in nerves distributed to the mammary glands, to the so-called "mammary neuralgia." The comparatively slight and fugitive pains of pleurodynia unassociated with tender points are to be regarded as neuralgic in character. Herpes zoster is seen with especial frequency in intercostal nerve areas (see HERPES ZOSTER, Vol V).

The writer has encountered a number of cases in which gastric dyspepsia, pain, and oppression in the stomach and retarded evacuation followed typical *intercostal neuralgia* with or without zona and zones of hyperesthesia, the digestive disturbances developing only after the neuralgia, of which they were thus evidently a complication, a visceral manifestation of a superficial neuralgia, which, as patients said, "settled in the stomach." Loeper (Arch. des mal. de l'app. digestif, Apr., 1910).

When the trunk is bent over to the side the seat of the pain, the pain increases in cases of *intercostal neuralgia*, while with pleurisy the pain increases when the trunk is bent over to the sound side. Schepelmann (Berl. klin. Woch., June 12, 1911).

The treatment of the intercostal form of neuralgias, as of the two preceding varieties, is that of neuralgia in general. Especially good results are obtained from **counterirritation**, preferably the **actual cautery**.

Typical case emphasizing the value of subcutaneous injections of **oxygen** used extensively by French, Spanish and Argentine physicians. The case was one of neuralgia of the right arm. The oxygen was injected into the subcutaneous tissues at the root of the arm, massaging afterwards to spread the gas. The pain disappeared the next day and had not returned during the months elapsed. Cetran-gelo (Semana medica, June 14, 1917).

Lumbar neuralgia, involving the branches of the lumbar plexus, presents few symptoms not seen in other forms of neuralgia. The condition of "irritable testis," with pain and syn-copal attacks, is probably based upon a neuralgia of the nerves of the part.

Coccygodynia is a neuralgia of the coccygeal plexus, most frequent, obstinate, and intractable in women, and often calling for surgical interference.

The ordinary treatment of this condition is by a **rubber cushion** to sit on, or even by a **resection**, often highly unsatisfactory. The following has proved almost uniformly successful: The coccyx is grasped between the forefinger in the vagina and the thumb on the outside, and is moved backward and forward. The soft parts are also moved about on the bone.

The **manipulation** is begun very lightly and gradually increased in force as the patient becomes less sensitive. Usually 2 or 3 treatments at intervals of two or three days suffice for a cure of the condition. L. W. Ely (Jour. Amer. Med. Assoc., Mar. 19, 1910).

Coccygodynia is due to dislocation of the coccyx from some trauma, either internal, during delivery, or external, or some shock or fall on the coccyx region. **Resection of the coccyx** puts an end to all the trouble, and entails no functional disturbance. Hammant and Pigache (Revue de chir., Jan., 1914).

Metatarsal neuralgia, or Morton's disease, is due to a depression of the arch of the foot, resulting from debility, or excessive body weight for the strength of the foot. It may also be due to too short or too narrow footwear.

Anterior metatarsalgia is often associated with a high degree of neurasthenia. The writer recommends a treatment consisting of **support** and developmental **exercises**, and describes an **appliance** which is light, durable, gives firm support where it is needed, and remains constantly in the right spot. Allison (Boston Med. and Surg. Jour., Feb. 25, 1909).

Early-discovered cases of metatarsalgia may sometimes be relieved by **changing** the poor **shape and style of shoe** to one of a broad, thick-soled, low-heeled type. But the final remedy lies, in difficult cases, in the **excision of the branches of the plantar nerve** which are **affected** by the pressure. The excision may be effected by opening over each affected branch of the nerve; but a single incision can sometimes be used for two branches. These nerves should be attacked at a point beneath the proximal extremities of the metatarsal bones. A single incision at this point gives an excellent opportunity to attack the nerve before its final major divisions have taken place. Van Hook (Ill. Med. Jour., July, 1913).

Neuralgia of the heel consists of pain and tenderness in this location which resist ordinary measures.

Painful heel is often due to acute inflammation of the os calcis, and there is frequently a history of gonorrhea, gouty rheumatism, or trauma. An X-ray picture will show exostosis of the os calcis, with a surrounding periostitis. The condition is curable by proper treatment—**removal of the offending exostosis** with **postoperative treatment of the underlying cause**. Steinhardt (N. Y. Med. Jour., Mar. 27, 1909).

Out of a number of cases of pain in the heel, the writer submitted 8 to operation. In a minority of the cases a "calcaneus spur" was found; in most of them, however, inflammation of the bursa between the os calcis and the tendo Achillis or of one of the plantar bursæ was found. In 4 of the cases inflammation of the bursæ alone caused the pain; in 2 additional cases the infectious bursitis seemed to be the cause of the formation of exostoses of the os calcis. Franz Koenig (Deut. med. Woch., Mar. 31, 1910).

Neuralgias of the nerves of the legs, described as crural, plantar, metatarsal, etc., present the usual features of neuralgia in general and need not here be elaborated.

Neuralgia of the rectum is a distressing form which fortunately readily responds to appropriate internal and local treatment.

The writers review the methods of treatment applied in neuralgia of the rectum by Loomis, of New York (chloral, bromides, acetphenetidin, cocaine suppositories, and morphine); Gant, of New York (applications of camphor, capsicum, and chloroform); Davis (belladonna); Einhorn and Gant (electrotherapy); Albu (dilatation and elongation of the nerves); but have found that brief tepid douches followed by hot douches, of three minutes' duration, are very beneficial. Parmentier and Foucaud (Presse méd., July 6, 1910).

Case of typical primary neuralgia of the rectum in a boy 18 years of age. The only treatment that gave permanent relief was **warm sitz baths**. Dritsaki (Roussky Vratch, Aug. 18, 1912).

MIGRAINE.

DEFINITION.—A form of severe paroxysmal headache often accompanied by nausea and vomiting. Called also "hemicrania," "neuralgic headache," "sick headache," etc.

SYMPTOMS.—Premonitory symptoms extending over a few hours to a day or two are not uncommon, these being mental hebetude, somnolence, or despondency, with vague uneasiness or ill-defined discomfort. Abnormal visual phenomena are also frequently seen prior to onset of the attack, these consisting of visual hallucinations, pupillary abnormalities, hemianopsia, and indistinctness of sight. Disturbances of other sense mechanisms are more rare, although sometimes shown, such as anesthetic areas about the head and face, aphonia, and transient mental disorder or confusion of ideas. Following these prodromal symptoms more or less closely, or accompanying them in quickly developing cases, we have the characteristic headache, at first unilateral, located in the temple, eye, or occiput, but spreading as it increases in intensity until it involves all of one side of head, or in some cases both sides. The pain is intense, throbbing, and is increased by movement, noises, light, and any worry or emotional strain. Nausea is usual and vomiting frequent, becoming, in the so-called bilious headache, very distressing. This vomiting in occasional cases gives relief, its occurrence marking the end of the attack; but the usual rule is that the pain is increased and rendered more unbearable by the vomiting. The face is sometimes flushed, sometimes pale; the pulse is slow and the arteries throb and have a sclerotic feel to the touch. There is great prostration and physical weakness, and complete loss of appetite. Temperature abnormalities are sometimes present, but are neither constant nor characteristic. The urine is sometimes abundant, some-

times almost suppressed. Constipation at the beginning of the attack is the rule. The duration of the paroxysm is variable, from a few hours to several days. Twenty-four to thirty-six hours of suffering are frequent, and in the severer forms the patient may be kept in bed three or four days. The attacks recur for years, or, in rare cases, through life. In old age they usually cease, and in many women there is complete cessation after the climacteric. The seizures in women are apt to occur at or near the menstrual periods.

The attacks subside slowly, as a rule. With the beginning diminution of the pain the patient falls asleep and awakes some hours later free from the pain and often feeling better than before the attack.

In young children sudden symptoms are sometimes seen, with headache, pyrexia, and general aspect of illness, often with vomiting. The symptoms cause a fear of acute meningitis, but after 1 or 2 days they rapidly pass away. At the other end of life the prodrome of migraine frequently occurs without or with but slight headache, and sometimes with more brief headache than occurs during middle life. Occasionally the loss of power seems to be the chief symptom, and in these cases the headache is generally so slight as not to attract special attention. With many patients an error in diagnosis readily occurs in a first attack of this character, although another one is less likely to be mistaken. Sir William R. Gowers (*Brit. Med. Jour.*, June 12, 1909).

DIAGNOSIS.—The diagnosis of migraine is without especial difficulty, the presence of the characteristic headache and other clinical symptoms above mentioned being all-sufficient. It is to be remembered that neuralgia

and other forms of headache may occur in a patient who suffers from migraine.

The diagnosis of migraine for the actual attacks are based by the writer upon the following points: (1) The marked hereditary tendency, direct transmission, and absence of other neuroses in the family. (2) The onset of the affection in most of the patients in childhood. (3) The characteristic visual phenomena preceding the headache, especially temporary hemiopia. (4) Headache, generally unilateral. (5) The vomiting which generally accompanies the onset of the headache, and after which the condition of the patient begins to improve. (6) Return to the normal in the interval between the attacks. (7) The temporary loss of speech and sensory disturbance, which are well-known features of some severe attacks of migraine. J. M. Clarke (Brit. Med. Jour., June 25, 1910).

PROGNOSIS:—Even frequent recurrence of migraine seems to have little unfavorable effect upon the general health, and life is not endangered nor probably shortened by the affection. The disease, as above said, often spontaneously subsides after middle life. Many cases are improved by treatment, in that the attacks are diminished in number and in severity, and the individual paroxysms may be aborted or quickly relieved.

A complete cure—*i.e.*, to the extent of entirely preventing recurrence of the headaches—is, however, rarely obtained by any mode of treatment yet devised. The outlook is more favorable where there is obvious, but removable impairment of health or some removable source of reflex irritation, such as eye-strain. The most unfavorable and intractable cases are those in which strong hereditary predisposition exists.

ETIOLOGY AND PATHOLOGY.—Regarding the pathology of the affection there are some differences of opinion. There are no discoverable anatomical lesions. The most tenable theory is that of Liveing: that the affection is a neurosis in whose course there occur periodical sensory discharges analogous to the motor discharges of epilepsy. Modern investigations, however, have traced both the latter disease and migraine to endogenous toxics, probably intermediate waste products derived from foodstuffs.

Of 1300 cases of migraine whose histories were reviewed, the families of 127 were studied as to heredity.

In 100 families, either the father or the mother had migraine, with 143 migrainous children and 488 non-migrainous children, or a ratio of 3.13 to 1.

Among 7 families in which the parents were migrainous, 10 children had epilepsy alone or a migraine-epilepsy syndrome; 37 children had neither epilepsy nor migraine, a ratio of 3.7 to 1.

Seven families were tabulated as crossing of persons with dormant migraine; the migraine in these was not present in the father or the mother of the family, but was present in the brother, sister, father or mother of the parents of the families studied. In this group, 30 children had migraine and 85 did not have migraine, a ratio of 2.83 to 1.

Three families were studied in which the presence of migraine in both parents was carefully investigated. All of the 15 children of this group had migraine.

The total number of children studied was 198 with migraine and 610 without, a ratio of 3.08 to 1.

The results of this study definitely establish the hereditary nature of the affection. Buchanan (Med. Rec., Nov. 13, 1920).

By others migraine is regarded as a neuralgic affection of the ophthalmic division of the fifth nerve. By others still the condition in question is looked upon as a "vasomotor neurosis."

Study of the uric acid (plus the purin-xanthin bases, forming about $1\frac{1}{2}$ per cent. of the total purins) metabolism in 3 cases of typical migraine. It demonstrated a deep-seated metabolic perversion partaking of the character of a "nucleolytic intoxication" and closely resembling similar conditions observed in gout and in other masked manifestations of atypical gout, and indicated an appropriate prophylaxis and therapy accordingly. Croftan (Interstate Med. Jour., Jan., 1912).

The frequent interchange of epilepsy and migraine in different generations of the same family clearly indicates a definite relation between the two diseases. In cases seen by the writer there occurred substitution of one neurosis for the other in the same individual. Symptoms of epilepsy in an attack of migraine may, however, indicate the existence of a relationship between the two diseases in that attack, and need not, according to the dictum of Moebius, stamp that attack as essentially epileptic. Waterman (Boston Med. and Surg. Jour., Mar. 5, 1914).

Ophthalmic disorders also prove causative in a comparatively large number of cases through reflex irritation of the ophthalmic division of the fifth pair.

Case of chronic catarrhal inflammation of the right frontal sinus entailing periodical attacks of intense migraine, as the secretions accumulated and compressed the nerve terminals in the orbit. Notwithstanding the long duration of the sinusitis, there was no pus. The case shows the value of examination of the nose and sinuses. Oertel (Berl. klin. Woch., June 13, 1910).

Case of ophthalmoplegic migraine which occurred only after parturition, appearing after each childbirth and subsiding within a few weeks. The external rectus of the right side was the muscle chiefly involved instead of the usual oculomotor paralysis; the case was peculiar also in the occurrence of multiple recurrent styies. The conditions point to a toxemia as the exciting cause. A. Brav (Jour. Amer. Med. Assoc., Mar. 14, 1914).

Hereditary predisposition is the most frequent and important etiological factor. Women of neurotic families are the greatest sufferers from the disease, although the affection is by no means uncommon in men.

Migraine is due to a vasomotor spasm in the cortical centers. This assumption is sustained by the 3 cases reported in which periodically recurring migraine was accompanied by hemiplegic conditions, which vanished with the other typical symptoms of the migraine within a short time. Renner (Deut. med. Woch., May 27, 1909).

Analysis of the family history of migraine in a family which showed a remarkable prevalence of migraine, unusual sensory manifestations in several of the cases, and the association of epilepsy with migraine in 1 case. Price (Monthly Cyclo. and Med. Bull., Nov., 1910).

It is more common among the educated upper classes than among the laboring class. It generally makes its first appearance at or near puberty; rarely, if ever, after middle life. Overwork at school or in business, worry, lack of open-air exercise, wasting and diathetic diseases predispose to the affection, and reflex causes are often traceable, especially disorders of the female generative organs and refractive errors and ocular muscular

insufficiencies. The exciting causes immediately preceding the paroxysm are manifold and various, it being also remembered that even when there is no exciting cause the rhythmical recurrence of the seizures will not be broken. As a rule, when the usual time between attacks has nearly or quite passed, any suddenly produced nervous impression will precipitate the attack.

The common exciting causes are: indiscretions in eating, excitement, fatigue, emotional outbursts (anger, grief, etc.), loud disturbing noises, visual impressions of moving objects (as of railway trains, passing crowds, a rapidly moving field in microscopical work, riding backward), etc. Toothache from carious teeth and the presence in children of adenoid growths in the nasopharynx act also as immediate causes, as do gastrointestinal disorders and leucomaine or ptomaine poisoning.

TREATMENT.—When, as is often the case, the patient is aware of the causes which produce the paroxysms the first requisite is a rigid **avoidance of these causes**. In this way the number of attacks may be materially diminished, although no amount of care will altogether prevent occasional recurrences. In children the first attack of hemicrania should suggest a careful **search for ocular insufficiencies or other possible reflex cause**, and in all children of neurotic families having a predisposition to migraine especial **hygienic precautions**, as to avoidance of eating excessively, long hours of study, etc., should be observed.

Prevention of migraine: 1. As to diet: Red meats are to be rigidly excluded; fish, bacon, brains, sweet-

bread, and eggs are allowed. Rich and highly spiced dishes are to be avoided. Coffee, tea, and alcoholic beverages are to be excluded. Sweets should be reduced; but when meats are excluded, a moderate amount is well borne. Water may be taken very freely. Meals to be taken at regular intervals, and overloading of the stomach to be avoided. 2. As much **outdoor exercise** is to be taken as possible—**undue fatigue to be avoided**; rooms always should be **well ventilated**, both by day and night, and **hot baths** taken two or three times a week. In some cases the **Turkish bath** is beneficial, and in others the morning **cold sponge bath** is directed. 3. The medicinal treatment aims to regulate the bowels, to promote intestinal antiseptics, and to stimulate the liver, the great organ for completing the oxidation of the products of metabolism and protecting the body from poisoning. The same end may be attained in many ways. The various **salicylates** are all useful. In obstinate cases an occasional **mercurial** is required. The best results have been obtained by the long-continued use of a formula recommended by Rachford:—

R. Sodium sulphate
(crystals) gr. cxx (8 Gm.).
Sodium phosphate gr. xxx (2 Gm.).
Sodium salicylate gr. x (0.6 Gm.).
Tincture of nuxvomica gtt. iij.
Distilled water,
to make ℥iv (120 c.c.).

This dose is to be taken before breakfast each morning, and is best taken in a glass of Seltzer, or, better still, the ingredients are made up in these proportions in large siphon bottles charged with carbonic acid. The proportions are variously modified in different cases. Mitchell (Jour. Amer. Med. Assoc., Feb. 9, 1901).

During the early stages and in the time of the gastrointestinal disturb-

ance, and during the stage of scotoma, **quinine** is the remedy *par excellence*, and it not only is the most effective remedy, but may be called specific. However, it must be given early at the onset and in sufficiently large doses. The author usually gives 7 grains (0.47 Gm.), and has rarely found it necessary to repeat the dose. Herzfeld (Jour. Amer. Med. Assoc., Nov. 18, 1911).

In the drug treatment of headaches the writers recommend the systematic use of **quinine sulphate**, 2 grains (0.13 Gm.), combined with **nitrate of aconitine**, $\frac{1}{400}$ grain (0.00015 Gm.), every two hours, and of **cannabis indica** in $\frac{1}{8}$ - to $\frac{1}{4}$ - grain (0.008 to 0.016 Gm.) doses of Hering's extract, three times a day. Of the coal-tar analgesics they prefer **antipyrin** guarded with **caffeine**. F. Coggeshall and W. E. McCoy (Jour. Amer. Med. Assoc., Jan. 4, 1908).

When an attack supervenes the first requisite is absolute mental and physical rest and quiet, and this in mild cases may be sufficient to give relief within an hour or two. Usually other remedies are required.

Of drugs the most valuable are the **coal-tar derivatives**, singly or in combination with one another, and **caffeine**, **sodium salicylate**, **guarana**, **ammonium chloride**, **bromides**, **chloral**, **cannabis Indica**, and a long list of similar drugs. **Antipyrin** is sometimes quite effective. **Acetanilide** (antifebrin) has also been recommended.

Therapeutic measures to be applied in the ophthalmic type of migraine. During the attack gentle and slow **massage** should be practised around the orbits, with especial pressure over the temporal arteries, or a weak **galvanic current** may be applied. The following cachets should be taken every half-hour until the limit of safe dose has been reached:—

R. Antipyrina gr. viiss (0.5 Gm.).
Acetphenetidini . gr. iij (0.2 Gm.).
Acetanilidi gr. iss (0.1 Gm.).
Caffeine gr. $\frac{1}{4}$ (0.05 Gm.).

M. et ft. in cachetam no. j.

If antipyrin has already been found inefficient, from 15 to 30 grains (1 to 2 Gm.) of **potassium bromide** should be given instead, or **cannabis indica** may be employed:—

R. Extracti cannabidis indicae . gr. $\frac{1}{4}$ (0.016 Gm.).
Acetphenetidini,
Acetanilidi ...ãã gr. iiss (0.16 Gm.).

M. et ft. in pilulam no. j.

In the intervals between attacks an important requirement is to correct any ophthalmic disorder, especially **errors of refraction**, from which the patient may be suffering. To exert a sedative effect on the central nervous system, appropriate **hydrotherapy** and the ingestion of **bromides** are both indicated. The first should consist of the application of **interrupted jets of lukewarm** (32° C.) **water** to the entire body, except the head and neck, for two or three minutes, followed by a brief application of **cold water to the feet**. The bromide may be prescribed thus:—

R. Potassii bromidi . 3iiss (10 Gm.).
Sodii bromidi,
Ammonii bromidi,
Sodii benzoatis, ãã gr. lxxv (5 Gm.).
Syrupi aurantii .. f3ij (60 c.c.).
Aquæ destillatæ,
 q. s. ad..... f3x (300 c.c.).

M. Sig.: One tablespoonful before dinner and supper.

Gastrointestinal disturbances, according to Robin, play an important part in the etiology of this affection. To correct these conditions **exercise** in moderation and life in the open air will be of assistance. **Mental fatigue** and the use of **tobacco** are both to be interdicted. In the diet restriction of the meats is especially to be insisted upon. **Stimulating beverages** of all kinds must be proscribed.

Each morning a half-tumblerful of an alkaline solution, prepared by dissolving the following salts in a quart of water, should be taken on an empty stomach:—

℞ *Sodii sulphatis* . . 3j (4 Gm.).
Sodii bicarbonatis. gr. lxxv (5 Gm.).
Sodii phosphatis . ʒiiss (10 Gm.).
 M. et pone in chartulam no. j.

Where constipation does not yield to these salts, the following combination may be used:—

℞ *Fluidextracti frangulæ*,
Fluidextracti rhamni purshianæāā f3vj (25 c.c.).
Glycerini f3x (40 c.c.).

M. Sig.: One teaspoonful in a half-glassful of water before retiring.

R. Oppenheim (N. Y. Med. Jour., from Progrès méd., Sept. 28, 1912).

One of the snuffs recommended by Lorand is formulated as follows:—

℞ *Mentholi* gr. viiss (0.5 Gm.).
Acidi borici ... gr. xv (1 Gm.).
Radiciis iridis,
Sacchari lactis.āā ʒss (2 Gm.).

M.

Lohman found that an attack could be cut short by **massage of the nape of the neck**, precisely at the insertion of the muscles into the occiput, while Andrews recommends **dietetic restrictions**. Andrist (St. Paul Med. Jour., Mar., 1913).

When other remedies fail, hypodermic injections of **morphine** will usually give prompt relief. Inhalations of **chloroform** may also be resorted to, but are not to be used when other means of relief will suffice.

The cause of the headache in migraine is almost certainly congestive, due to dilatation of the superficial arteries following the initial vasomotor spasm which produces the aura of hemianopia, color spectrum, tinglings, aphasia, etc. To relieve the actual pain cardiac depressants, such as **chloral** and the **coal-tar analgesics**, are often successful by lowering

blood-pressure, the patient being kept quiet lying down, with the head as high as possible. Ten grains (0.6 Gm.) of **Dover's powder**, followed by a hot drink containing ¼ grain (0.01 Gm.) of **nitrate of pilocarpine**, promotes perspiration and may give speedy relief. Harris (Pract., Oct., 1909).

The danger of the establishment of a drug habit should be constantly borne in mind, and the patient be not permitted to use opium, chloroform, or similar remedies indiscriminately nor on his own responsibility. It is also noteworthy that each case must be treated individually, and that remedy employed which experience shows gives in the particular case most relief with least subsequent harm. What will entirely and quickly cure one patient may produce absolutely no effect upon the next case, and after long use any drug is liable to partially lose its effect.

Potassium iodide used in migraine to the exclusion of all other remedies. The writer was led to its administration by the observation that a great similarity existed between migraine and cerebral syphilis, the headache of both being characterized by pain that is deep seated, constricted, of great intensity, with nocturnal exacerbations, long durations, and relapses. There is also present raised arterial tension. The author found that in the most aggravated cases potassium iodide in 5- to 15-grain (0.3 to 1 Gm.) doses, three times daily, diminished both the frequency and severity. J. R. Clemens (Therap. Gaz., May 15, 1903).

Ordinary migraine in the adult or child is usually of thyroid origin. In 10 cases of their own, of migraine in children, which the writers treated with **thyroid** they observed cures, or amelioration of the symptoms if the treatment had not been long continued. The migraine of childhood

is undoubtedly of thyroid origin. They advise small doses of thyroid extract, usually 5 mg. ($\frac{1}{2}$ grain) at first, and find that larger doses often make symptoms reappear which had disappeared under small doses. In their 10 cases they found immediate amelioration of symptoms. Levi and de Rothschild (*Progrès méd. belge*, May 1, 1912).

Other measures than the administration of medicines also give frequent and marked relief. Of these the galvanic current to the temples and back of neck ranks first, often breaking up an attack, and when used continuously for some weeks diminishing to a great degree the tendency to migrainous attacks. Counterirritation to the head by the actual cautery, mustard plasters, menthol, etc., is frequently helpful, as is also a hot foot-bath.

During the intervals between the paroxysms hygienic measures directed toward the improvement of the general health are indicated. The long-continued use of cannabis Indica in moderate doses or of nitroglycerin and the bromides seemingly exerts a favorable influence over the

course of this disease, and in at least some cases gives great relief by reducing the number and severity of the attacks.

Personal belief, founded on ten years' study that migraine is due to poverty of the cortical centers in phosphorus. The supervision of attacks while the mind is active, the disappearance of attacks during sleep, the stimulation with consecutive paresthesia of the optic and acoustic nerves (this constituting an aura), with similar involvement of the arm center, all point to a cortical location. The headache is attributed by the writer to increased sensitiveness of the cortical sensory centers, which is propagated from the cortex to the vomiting center. He, therefore, treats migraine, i.e., the tendency to the paroxysms, with a non-toxic combination of phosphorus and lecithin in oil. The favorable results claimed seem to be the principal reason for the belief in the phosphorus-starvation theory of the origin of this neurosis. Schottin (*Münch. med. Woch.*, May 23, 1911).

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NEURALGIA AND MIGRAINE. See NERVES, PERIPHERAL, DISEASES OF.

